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THE PROMOTION OF INDUSTRIAL EFFICIENCY AND NATIONAL PROSPERITY.

By John B. C. Kershaw.

III. THE FUTURE, AND TRADES-UNION HOSTILITY.

Mr. Kershaw's review of labour conditions, which began in our June number, is based primarily upon the situation in Great Britain, but for this very reason has the strongest interest for American readers—for unionism in America is patterning after unionism in England, and the situation in Britain today will be the situation in the United States a very short time hence. The rapid spread of the false philosophy of trades unionism in the States during the past few years is fast levelling down the industrial advantage they confessedly had but a little while ago. The vital need, therefore, is the enlightenment of the union leaders—the patient, conscientious effort of all concerned to dispel the fallacies by which labour has been so disastrously led in so many cases, and to establish true ideals of industrial economy for the guidance of employers and employees alike. It is for their value in this work that Mr. Kershaw's contributions have been welcomed to our pages.—THE EDITORS.

THE preceding article discussed the two chief causes of failure in relation to schemes of profit sharing in Great Britain in the past, and suggested a modified form of the American premium system of payment, in place of the usual bonus system of reward.

It is now necessary to consider the chief hindrance to the extension of the movement in the United Kingdom at the present date. This undoubtedly is the indifference, or active hostility, of the trades-union officials towards all forms of payment based on the results of individual effort.

In no case known to me has the movement received any welcome or support from these leaders of the workmen's cause. The reasons given for this attitude are four. It is asserted that firms who inaugurate schemes of this kind take the step for the express purpose of

breaking up the unions, and thus diminishing the collective power of the men. The second objection is that premium systems and schemes of profit sharing are insidious forms of payment by results, and are based on no fixed principle. They are therefore in direct antagonism to the trades-union principle of fixed rates of payment for specific work, without regard to the final profits that may be earned by the firm or employer. It is further contended that these systems would lead to varying rates of remuneration for the same forms of work in different works or factories, since the premium, or share of the profits accruing to the workers, would be greater in the larger and better managed undertakings. These latter would thus have a command of the best workers, and further increase their advantage over their less successful competitors. Finally, it is urged that these systems lead to selfish indifference of the worker to the condition of his brother workers, and so far from being a step forwards, are a step backwards in industrial evolution.*

With regard to the first objection, there has certainly been some ground for the fear that profit sharing was a direct attack on unionism, since in one very notable instance the scheme was inaugurated in order to "smash" the union; and in other cases, withdrawal of workers from membership in trades unions has been made a condition of participating in the benefits of the scheme. But there is no actual necessity that this should be the case, and in many of the instances in which profit sharing is in successful operation today, the employees are members of their respective trades-union organisations. The numerous conflicts which have occurred in the past between the unions and employers, upon the wages question, have however fostered the idea that the unions exist solely as fighting bodies. The extensive adoption of a plan which seems to settle the wages question upon a reasonable and just basis, is thus felt by trades-union leaders to threaten the continued existence of these organisations, which they regard (perhaps from rather mixed motives) as so essential to the maintenance of the worker's prosperity and progress. But is this idea of fighting bodies essential to the existence of trades-unions? The latter are simply bodies of men, engaged in the same or similar occupations, associated together for the purpose of protecting and furthering their corporate interests.† They differ from societies of professional men, as for instance of doctors, solicitors, chemists, merely in the status and educa-

* "Industrial Democracy," S. & B. Webb, Vol. II, pp. 549-558. "The Co-operative Movement," B. Potter, pp. 161-169.

† "Economics of Industry," Marshall, 1898. Chapter 13.

tion of their members. They can perform useful service, even if they never come into actual conflict with employers upon the wages question. Whatever may be the judgment as to the gains or losses of the struggles that have occurred in the past, there can be little doubt that in the face of the severe and growing competition which British manufacturers are now meeting in all parts of the world, trades unions will in the future best serve the interests of their members by utilising their forces in the promotion, not of industrial war, but of industrial peace.

The bonus and premium systems of payment offer distinct advantages for the peaceful settlement of the wages question in all large industries, if based, as I agree they should be based, upon trades-union rates of wages, and if a definite percentage of the surplus profits be set aside each year as the bonus fund. There are many directions in which the trades-union organisations could give useful help and information in this peaceful development of future years. By the collection and publication of statistics and laws relating to labour in other countries, notably those of their chief industrial competitors, they might educate their members to broader and sounder views upon industrial affairs, and promote that levelling up of labour conditions in eastern countries which will lessen the burden of competition, and remove the danger of retrogression in the workers' standard of comfort in their own. By the collection and publication of scientific and technical notes upon the industries or handicrafts in which the workers are engaged, they can increase the knowledge of their members and render them more efficient parts of the industrial organism. I know one instance only, in which a workers' union has commenced this kind of work. Why are there not more?

An important step in this direction by one of the largest and most powerful unions in the United Kingdom is however reported in the *Times* of June 21, 1902. A hall of residence for workingmen, called the Ruskin Hall, has recently been founded at Oxford, and money is urgently needed for the continuance of its work. The Amalgamated Society of Engineers have therefore promised to make a levy of one penny per member in aid of its funds. It is to be hoped that this promise may be fulfilled, and that it may be the forerunner of many similar attempts to interest the members of trades unions in social and educational movements for the benefit of the whole body of workers.

Should any satisfactory old-age pension scheme be launched in Great Britain, the trades unions, embracing as they do immense numbers of the wage-earning classes, might be of great service in the administration of the scheme, and in the collection of the contributions

which might be required from the employees and workers in the various industries. It may prove impossible for the present Government to fulfill their election promises in regard to old-age pensions, but the trades unions officials, in conjunction with the employers, might be able to work out and administer a superannuation scheme for the benefit of the workers in particular industries, untilising for this purpose the invested portion of the bonus funds.

The trades-union organisations could therefore fulfill many useful purposes in the future, even should the extensive adoption of profit-sharing principles render wages disputes of rare occurrence; and it has undoubtedly been a mistake in the past for any of the employers to make withdrawal from the unions a condition of their workers' participation in the benefits of profit-sharing schemes. The stipulation is a wholly unnecessary one, and has hindered the progress of the movement by arousing the hostility of the union officials. These have felt that their extinction was threatened, and they have very naturally thrown all the weight of their influence against the adoption of schemes of this character,

With regard to the second and third objections to all forms of profit-sharing, urged by the trades-union leaders, it must be pointed out that the schemes are based upon payment of minimum fixed rates of wages for the different forms of work; and that in all the instances of which details have been given in the preceding articles these rates are the trades-union rates for the district in which the works or factory is situated. The premium, or share of the bonus fund apportioned to each individual worker, is thus an *addition* to the trades-union rates of wages, and undoubtedly differs in different works and in successive years; but since there is a definite limit below which the wages cannot fall, these two objections lose much of their force. Systems of this kind are, in fact, simply minimum-wage systems, worked in conjunction with a bonus system; and the net result is that the worker receives trades-union rates of pay, *plus a sum of money* paid weekly or annually, the amount of which depends upon the surplus profits of the year's operations. The objection that no fixed principle underlies it would be removed if all firms adopted the basis of say 5 per cent. as the normal rate of interest for capital invested in industry, and divided the profits earned in excess of this rate of interest more equally between capital and labour. A fairer or more just system of payment cannot be conceived, and trades-unions officials in continuing to oppose its adoption will be guilty of grave disregard of the workers' interests.

The fourth objection, that these systems promote selfishness, is one which becomes of little weight if the participants retain their membership in the respective trades unions, and use their influence in widening the area of adoption of such schemes, and in promoting the usefulness of their own unions in accordance with the ideas already expressed.

The objections of the official trades unionists are thus seen to be based upon misapprehensions as to the effects of premium and bonus payments on themselves and the workers, and to some extent upon a mistaken view of the true functions of unionism.

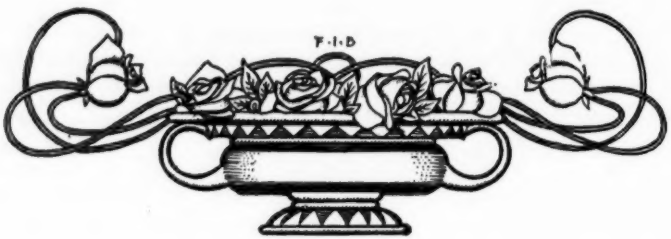
If the labour leaders could be won over to a recognition of these facts and could be induced to give not only their sanction but also their active support to all schemes of this character, there is not the slightest doubt that the movement would rapidly spread, and that the twentieth century would be characterised by a startling improvement in the relationship between capital and labour in all manufacturing industries. The recent decision of the Amalgamated Society of Engineers to countenance premium systems of payment in the engineering industry is a hopeful augury for the future. Should the larger number of trades-union officials, however, persist in their present policy of indifference or active opposition, progress will be hindered, it is true, but it will not be absolutely checked. In the past the trades-union leaders have often obtained the support of the outside public, because it was seen that in their struggles with the employers justice was on their side. They cannot expect, nor have they any right to receive, such support in the future, if under a mistaken conception of their duty they fight against reforms which will improve the financial position of the working man, and at the same time strengthen the position of their country as a manufacturing nation.

In conclusion, it must be pointed out that premium and profit-sharing systems alone will not suffice to place the relations between capital and labour upon an entirely just and satisfactory foundation. To quote from an article by Mr. H. F. L. Orcutt upon "Machine-Shop Management," which appeared in the issue of THE ENGINEERING MAGAZINE for June, 1899.

> "The factory and machine-shop hand is becoming the slave of the automatic machine and the model shop. No diversity in his labour, no development in his mind, no progress from his experience. This is the danger to American workers. Both continents are striving for the ascendancy in home and foreign markets, but we rarely find a manufacturer who realises that social economic problems exist. How keenly are

all bent on studying the machine, its design, its output, care, and development. How few take any thought for the care and development of the human machine, the most important of all factors in reducing the cost and improving the quality of the product. How many employers think of the condition of their work-people as often as they do of their truck horses, of their stokers as well as of their boilers; what manufacturer cares as much for the food of the milling hand as he does for the quality of the lubricant of the machine which the milling hand attends, or gives as much anxious thought for the longevity of the turner as for the lathe which the turner runs? Who would expect profitable returns from a machine quartered in the damp and stifling atmosphere in which thousands of our factory hands live?"

The physical and social conditions of the workers, both in the factory and outside of it in their homes, cannot be neglected in the competitive struggles of the future; and those manufacturers will be most successful who have the financial courage to combine a system of premium or bonus payment with the arrangements for physical and social comfort, common in the larger German establishments. It is not claimed that the general adoption of such a combination would at once remove all occasions for friction and differences between employers and employees, or that it would usher in an industrial millenium. But it would afford ground for settling one of the most fruitful sources of difference, namely the wages question, upon a perfectly fair and just basis. It would teach both the workers and those who benefit by their work—the directors and shareholders of limited liability companies—that their interests are not antagonistic, but common. It would lead to an enormous increase in the efficiency of labour, and would prove a step—a fairly long step—on the road that runs towards "Industrial Peace."



AN INTRODUCTION TO THE STUDY OF ALLOYS.

By Henry M. Howe.

By special arrangement with Professor Howe, made at about the time he first entered upon the work of writing his great treatise on alloys which is shortly to appear in book form, and with the co-operation of his publishers, Messrs. Sauveur & Whiting, THE ENGINEERING MAGAZINE presents these papers selected and condensed from the forthcoming volume "Iron, Steel and Other Alloys."

The portions thus taken for advance publication are those which lend themselves most readily to magazine use for an audience vitally interested in the accurate knowledge of materials of construction, and in the elements of the science which gives that knowledge. For anything more than the outline permitted by these limitations, the student must be referred to the book. Of Professor Howe's foremost authority on the subject it is needless to say a word. It is internationally recognized. It is proper to say that on account of his present absence in travel the final proofs of the article which appears below have not had the advantage of his personal revision.—THE EDITORS.

BESIDE the general interest which we have in understanding the constitution of alloys, as giving us an intelligent view of the matter in general, we have the special reason that a knowledge of the subject promises to be of the greatest pracical value in approaching the study of any given series of alloys, for instance to one seeking to learn what are the most valuable alloys of two given metals. The case reminds us of the calculus. If we have the formula of a given curve before us we can by means of the calculus discover where all the critical points of that curve will lie without going to the trouble of plotting it throughout. Somewhat so is it with the examination of the constitution of a series of alloys, say those of bismuth with tin, or antimony with copper. The constitution of such a series may be expected to vary from one end of the series to the other; but in passing thus from end to end of the series there may be important critical points, at which not only the constitution changes but the nature of that change itself changes abruptly. Such points may be called critical points for constitution. And, just as the calculus reveals to us the critical points of a curve of known formula, so it happens that these critical points for constitution may often be laid bare by means of a few easy experiments.

Now the importance of this lies in the fact that the critical points for constitution may be expected to be also critical points for the useful properties. If we seek ductility, we may expect to find a critical point for ductility in that part of the series where lies a critical point for con-

stitution: there we may expect to find either a maximum or a minimum of ductility; and so with many other useful properties.

Thus it is that the methods which promise to reveal to us with relative ease the probable constitution of a series of alloys of any two metals, of learning where its critical points lie, and indeed whether it has any critical points, thereby promise to teach us where in that series we shall probably find those alloys the properties of which will differ markedly for better or for worse from those of the component metals; and indeed, whether or not we are likely to find any alloys in the series which do differ markedly in their physical properties from the component metals. The knowledge of the constitution of a series of alloys in short gives us a method of superior analysis of the problem of where to find in that series the most valuable alloys. These indications, of course, are not conclusive; indeed we have still far more to learn of their meaning than we yet know; but already they are of great value as in pointing out the part of the field most likely to be fruitful.

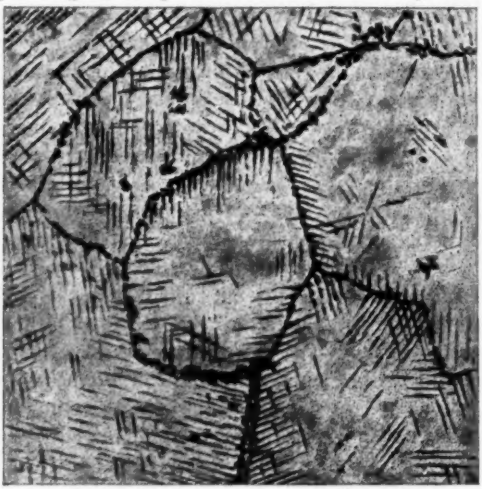


FIG. I. PEARLITE WITH FERRITE (SORBY).
The polygons are pearlite; the network is ferrite.

In inorganic matter we have three important classes of substances:

1.—Pure elements,

2.—Definite chemical compounds of those elements, and

3.—Solutions.

In the same way we recognize in our alloys three classes of ultimate constituents:

1.—Pure metals,

2.—Definite chemical compounds of those metals with each other, such as $AuAl_2$, antimonide of copper (Cu_8Sb_3?), and antimonide of tin (SnSb), and also to a smaller certain extent definite chemical compounds of metals with the relatively small quantities of certain metalloids, such as carbon and sulphur, present in some alloys. In this latter class of compounds the most important is the carbide Fe_3C found in steel, and commonly called "cementite,"

3.—What are now called solid solutions of metals in each other.

FIG. 2. MICRO-STRUCTURE OF A CRYSTALLINE ROCK.

Any given piece of an alloy may at the same time contain substances of each of the three classes. Here, as in so many other respects, the alloys remind us of the crystalline rocks, which they resemble in the general conditions of their formation. Crystalline rocks have cooled either like most of our alloys from a state of fusion, or at least from a temperature so high that the atoms present in the rock-mass have been free to arrange themselves, to combine to form definite compounds, and these compounds have been free to obey their crystalline laws. Under the microscope we find that our rocks consist of three classes of substances:

1.—Pure metals, such as native copper, native gold, etc.,

2.—Definite chemical compounds, like feldspar, mica, quartz, hornblende, and

3.—Glass-like obsidians, in which the chemical elements are united, not in any definite ratio, but indeterminately.

FIG. 3. STRUCTURE OF SLOWLY COOLED METAL.

Just as the particles of these different substances, the feldspar and other minerals, often exist in such minute particles that they can be detected only under the microscope, so in most cases the components of our alloys are visible only under the microscope, and often only with very great magnification, which may sometimes have to reach a thousand diameters. Fig. 1 gives us an idea of a common type of structure among our alloys, and it will be seen that it is strikingly like that of the crystalline rocks shown in Fig. 2.

The resemblance between alloys and crystalline rocks does not stop here. Indeed, we find close analogies between our metals on one hand and our crystalline rocks on the other, both of which result from the gradual solidification of fused or semi-fused masses; and also between both of these classes of solids and those which, like ice, result from the solidification of aqueous solutions instead of fused masses. Let us notice some of these points of resemblance.

First, the columnar structure familiar to us in the Palisades of the Hudson, the Giant's Causeway, and like rock-masses, forming enormous columns, we find reproduced both in metals and in ice. The columns of the Palisades were formed during the slow cooling of the

rock-mass which they form; and they stand upright, i. e., with their length at right angles with their upper surface, which was the cooling surface, the surface through which the heat escaped from them while they were cooling down and changing from a molten glass or obsidian to a solid rock. We find in slowly cooled metals this same columnar structure, with the columns standing at right angles with the cooling surface, i. e., with the outer surface, as is shown in Fig. 3; and in large blocks of ice, especially in the ingots of artificial ice which we see about the streets, we can often trace this columnar structure, with the columns at right angles with the cooling surface, i. e., with the sides of the ice-ingot.

Next we find in solidified ingots of steel a contraction-cavity called a "pipe" at the upper end of the axis of the ingot (Fig. 4); and you will generally see a similar pear-shaped cavity in the upper end of the ingots of artificial ice about the streets.

Next the beautiful specimens of minerals which adorn our mineralogical cabinets generally form in the cavities or "vugs" as they are called in the rocks; beautiful crystals of iron at times occur also in the cavities in our steel ingots (Fig. 5); and in the same way we will often find most beautiful minute crystals of ice in the pear-shaped pipe of our common ingots of artificial ice. Again, just as the crumpling of the rocks of the earth's crust produces what is known as a schistose structure, so we find such a structure in masses of iron when they have been crumpled in like manner.

Finally, gases evolved during solidification cause gas-bubbles or "blowholes" in ingots of ice and of steel, and also in glass (*A* and *B*, Fig. 4). These blowholes form at a time when the mass is still fluid enough to be pushed aside by the particles of gas evolved within it, so that these come together to form gas-bubbles; yet not fluid enough to permit these bubbles to rise by gravity to the upper surface and thus escape. So these bubbles remain entangled in the viscous mass.

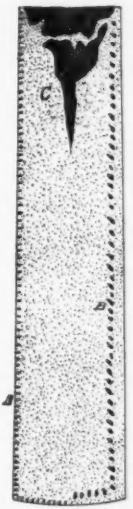


FIG. 4. PIPE AND BLOWHOLES IN AN INGOT.

While the condition of the particles of pure metals which we find in our alloys calls for no special comment here, that of the chemical compounds and of the solid solutions requires a word.

The chemical compounds of one metal with another do not in general follow the law of valence, so that they are of the type known as "molecular." The law of valence retains its importance, but we must recognize

STEEL CRYSTAL, A LITTLE LESS THAN ONE-HALF NATURAL SIZE. COLLECTION OF PROF. TSCHERNOFF.

that it is not a universal one. And it is in accordance with this general idea that even the definite chemical compounds of one metal with another, as of copper with antimony, or gold with aluminium, or tin with antimony, as they do not follow the law of valence, are feebly combined, and that their properties differ from those of their component metals in a very much less degree than is the case with the common strong chemical compounds with which we are familiar in inorganic chemistry. The properties of water are wholly different from those of hydrogen and oxygen; the properties of common salt give no suggestion of those of either chlorine or sodium. Naturally we find no such striking difference between the properties of a definite compound of aluminium with gold on one hand, and the properties of aluminium and of gold respectively in the other.

The term "solid solution" is used to distinguish these substances from solid definite chemical compounds. We mean by solid solutions those solids which are to definite solid chemical compounds, like salt, what liquid solutions, like salt water, are to liquid definite chemical compounds, like pure water itself. We mean solids which have the essential characteristics of solutions so far as solidity itself permits.

To understand this let us ask what are the essential properties which distinguish our common liquid solutions from definite chemical compounds. In a definite chemical compound we have two essential features, (1) complete and absolute merging of the compo-

nents into a new and different substance, chlorine and sodium losing their identity absolutely and forming a wholly different substance, common salt; and (2) a mathematically fixed ratio between the two components. In the case of solution, while this fixed-ratio feature is lacking, we have this same complete merging of the two substances. In a solution of water and alcohol we can neither by the microscope nor by any other means detect either the water or the alcohol; they unite to form a new substance: neither gravity nor centrifugal force separates them; the light alcohol does not rise to the surface, nor does the heavier water sink. This complete merging of their components and the absence of fixed ratio between these components, then, are the two essential characteristics of our common liquid solutions.

As the chemical forces which hold the dissolved bodies together in the new substance, the solution, are relatively feeble, naturally the properties of the solution do not differ markedly from the mean of the properties of the two bodies dissolved in each other.

Turning to the solid state we find in our glasses a similar state of affairs, except that the glasses are solid while common solutions are liquid. The silica, lime and alkali of the glass are absolutely merged; neither the microscope nor any other means enables us to detect either silica or lime or alkali as a separate entity in the glass, so long as it remains a glass. Only when we destroy it, tearing it asunder by analysis, can we detect any of its components. We have then in the glass a chemical merging of the components; but it is in indefinite ratios. The percentage of silica or of lime can vary by infinitesimal gradations from specimen to specimen, and this variation is accompanied by corresponding progressive change in the physical properties. The change from specimen to specimen, then, both in composition and in properties, is *per gradum* whereas the changes from one definite chemical compound to another, from water to hydrogen peroxide for instance, are *per saltum*. The glasses then have these two essentials of solutions, the substances present are (1) completely merged, but (2) in indefinite proportions.

In the same way many of our metals, as it were, dissolve in each other, and we find them in the solidified state completely merged in each other, forming alloys which differ from specimen to specimen by infinitesimal gradations, and yet the component metals cannot be distinguished in the alloy by the microscope or by any other means. The separate individual existence of each has ceased. Here then we have the essential characteristics of solutions, viz., (1) complete merging of the components (2) in indeterminate proportions; and on this account we give to these substances the name "solid solutions."

And just as the properties of the liquid solution, its color, density, electric conductivity, etc., do not differ markedly from those of the mean of its components, so we find that the physical properties in general of those alloys which are solid solutions do not differ markedly from the mean of the properties of the metals which compose them.

Liquid solutions, as we know, are habitually homogeneous, because in the liquid state diffusion takes place with considerable rapidity, so that even if a solution is initially heterogeneous, diffusion tends to make it homogeneous. From the conditions under which they form, however, and from the slowness of diffusion in the solid state, we should expect solid solutions to be heterogeneous.

As the science of petrography was in an advanced stage when that of metallography, of the constitution and structure of metals, was in its infancy, we naturally ask why the methods so fully developed for petrography have not been applied to metallography.

We may say that the essential procedure in petrography is to recognize the minute or even microscopic crystalline grains in our rock-masses by examining them with the microscope and with the polariscope, and by finding that they have the same crystalline form, and the same effect on polarized light, as the large crystals of the same minerals with which we are already familiar in the form of our cabinet specimens. Having determined accurately the crystalline form of quartz and its effect on polarized light by the study of large-sized cabinet crystals, we are able to recognize minute or even microscopic crystals of quartz by finding that they have the same crystalline form and the same action on polarized light. Manifestly, this method is wholly inapplicable to metallography. In the first place there are very few metals and alloys of which we have cabinet specimens suitable for standards with which to compare the crystalline form or other properties of the microscopic crystals which we find in our alloys.

Moreover, the metals and their alloys are opaque, so that the polariscope is wholly inapplicable. The discovery of the X-rays may have given rise to the hope that by them we could meet the difficulty of the opacity of our metals; but reflection shows that this hope was vain. For in most cases the particles of the different components of our alloys are so exceedingly minute that any individual grain of crystal would occupy but an insignificant fraction of the thickness even of the thinnest possible section, so that any given X-ray, in passing through such a section, would pass not through one individual grain or crystal of a given component, but through many different superposed crystals of all the different components which were present. In this way the shape of each one would be completely obscured and eclipsed by that

of the other, and the effect of any given particle upon the X-rays would be masked by the effect of the other crystals through which that same ray would pass. There are indeed a few cases in which the individual crystals are large enough to be thus outlined by the X-rays, but even in these cases the structure can be more readily detected by microscopic study of the surface after it has been properly prepared. Thus the X-ray method is without either present or prospective value.

The chief method actually used in metallography is to correlate the results of our examination (1) of the structure as revealed by the microscope, (2) of the physical properties of individual alloys, and (3) of the physical properties of series of alloys taken as a whole.

Many of our alloys, as has been already pointed out, have a granitic or porphyritic structure; that is to say, like a granite they are composed of distinct grains, each grain being some one distinct entity, and of a distinct mineral species; and the different grains are of two or more different species. In the case of common granite there are grains of three different mineral species, mica, quartz and feldspar, lying side by side; and any individual grain is of some one of these species.

Now, the composition of granite taken as a whole is indeterminate, in the sense that, if we take a series of different granites and determine their ultimate composition, we find that the percentage of silica or of lime varies by irregular gradations from one specimen to the next; and the percentage of these components might vary by infinitesimal gradations from one granite to the next.

So many of our alloys are granitic or porphyritic. They are found by the microscope to consist of grains or crystals of different definite substances. Each grain is of some one of these substances, and these different unlike grains lie side by side, like the mica, quartz and feldspar of a granite. The substances which compose these different grains in our granitic or porphyritic alloys may be (1) pure metals, or (2) definite chemical compounds of two or more metals with each other in rigidly fixed atomic proportions, such as aluminide of gold ($AuAl_2$), antimonide of copper (Cu_3Sb_3?) and antimonide of tin (SnSb), comparable with the chemical compounds with which we are familiar in common inorganic chemistry; or (3) definite chemical compounds of a metal with a metalloid, such as the iron carbide (Fe_3C) called *cementite*, which plays a very important part in the metallography of iron and steel; etc, etc. One aim of microscopic examination is to ascertain whether the alloy is of this porphyritic type and consists of different distinct crystals of definite chemical composition, or whether it is of the obsidian type consisting solely of a solid solution; or whether it contains both definite minerals and also solid solu-

tions. The further aim is to distinguish the shape, size, and the properties both physical and chemical of these various components.

The first step in general is to polish the metallic mass so that a large field may be visible under high magnification. The second is to subject it to an attack, either chemical or mechanical, which will affect the different constituents in different ways, and thus enable us not only to distinguish one from another but also to determine the shape, habit, and properties of each. Of these methods five deserve mention here. Of these the first three are chemical, the fourth mechanical, and the fifth partly chemical and partly mechanical. They are as follows:

(a) *Simple attack* by some solvent such as nitric acid, iodine, or licorice, a method which we owe to Sorby. Such a method may dissolve away one component more than another, or color one component differently from another, or it may simply eat away the joints between adjacent grains of crystals, and thus disclose their shape when they are later examined under the microscope.

(b) *Weyl's Method,* which has received great development in the hands of Charpy, is to attack by means of a solvent under the influence of a very gentle electric current. Charpy uses as the two poles (1) the alloy which is under examination and (2) at times platinum and at times another alloy of a composition so nearly similar to the first that the electro-motive force shall be very feeble, and therefore that the attack shall be extremely gentle. This gentleness is needed in all our methods. The particles which we wish to recognize and identify are so extremely minute, and often so feebly held in place, that we must use the utmost gentleness, whether in dissolving or in mechanically separating one from the other, lest we remove mechanically those components which we seek to leave untouched.

(c) *Heat-Tinting.* The different constituents may be differently colored by gently heating the polished surface, so that the more oxidizable ones become covered with oxide tints. This method has been used by Guillemin, and later by Stead, with most valuable results.

(d) *Relief Polishing.* Beyond these we have the mechanical methods, of which Osmond's "relief-polishing" is very important. By prolonged very gentle polishing, the softer constituents of a conglomerate alloy are worn away, leaving the harder ones standing in relief.

(e) *Osmond's "attack-polishing"* combines the chemical and mechanical methods happily. He polishes the surface while it is exposed to a reagent which attacks or colors the different constituents differently, so that disintegration by the reagent and removal by the rubbing go hand in hand.

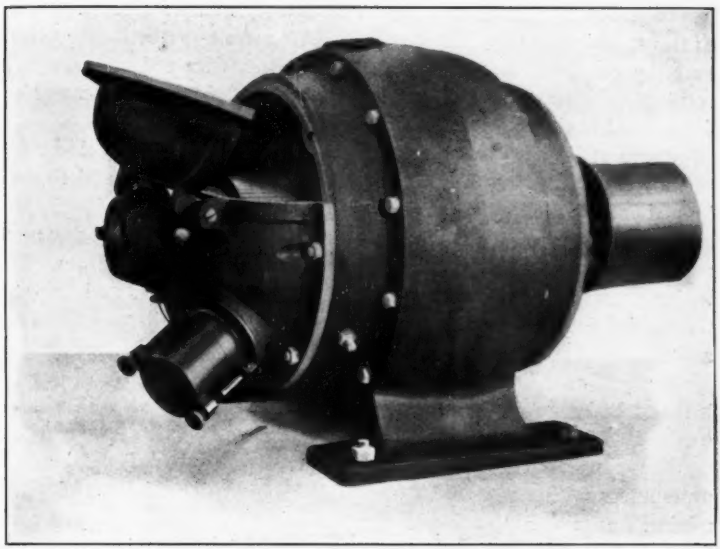


Fig. 1. 25-horse-power direct-current mine motor, Brioschi, Finzi & Co.

ELECTRIC POWER APPLIANCES IN THE MINES OF EUROPE.

By Emile Guarini.

There are, as M. Guarini points out, few departments of engineering in which electricity renders more efficient aid than it does in the operation of the mine. This general survey of the field from the viewpoint of Continental practice will be followed by a second article dealing specifically with the adaptation of motor driving to the larger power uses and the more important primary operations of mining.—THE EDITORS.

THE substitution of mechanical power for human or animal labour is one of the most characteristic tendencies of our age, which indeed is marked by an almost feverish activity in this direction. This tendency is far more advanced in America than in the older Continent, but this is by no means saying that Europe is neglecting machinery in its adherence to manual labour. That would be ultra-conservatism. One could hardly conceive, at the present day, of a mine being pumped by hand, of the tramming and hoisting being done by manual effort solely, or of the stoping being carried on with no tools but hand drill and pick and no power but the arms of the miner.

Such a mine could not pay expenses. The manifest advantage of the use of power in the mine has led to the introduction of divers systems of transmission and application—by rods, by steam, by hydraulic pressure, by compressed air. But all these systems have disadvantages, some of them so great that the continuance of their use has been only for lack of something better.

Pump rods, with their huge dimensions and despairing slowness of movement, require an enormous expenditure of power; add to the loss of energy the high initial cost of the installation, and it is easy to see why they were abandoned as soon as possible for other systems more economical, though still not free from faults. Steam, water under pressure, and compressed air, all require piping, and this is their chief drawback. The pipes are difficult to install, to maintain, and to keep tight. Their length and the attendant friction and leakage losses diminish the efficiency. Added to that in the case of steam is the moist heat of the mine which affects injuriously the health of the workers and the condition of the timbering.

These serious disadvantages of the older methods explain the promptness with which the study of the application of electricity to mining was taken up as soon as its possibilities were realized, and the field was actively entered by many large electric companies, working in collaboration with machine and tool builders for the production of mining machinery specially adapted to electric driving—companies such, for example, as Siemens & Halske, the Allgemeine Elektricitäts Gesellschaft and Union Elektricitäts Gesellschaft, the Helios, Schückert & Co., and Ehrhardt & Sehner, in Germany; Ganz & Co. in Austria-Hungary; Westinghouse, the General Electric Co., and Johnson & Philips, in England and the United States; Brioschi & Finzi in Italy; Electricité & Hydraulique in Belgium; the Oerlikon Co. in Switzerland. And from this collaboration of electrical and mechanical engineering manufacturers and the care with which the complicated and delicate problems were worked out by them, has sprung the movement which has planted on the Continent many installations of electric mining machinery, by which the exploitation of mineral deposits has been made more certain, more economical, and more comfortable for the mine workers.

The rapid growth in the use of electricity is therefore explicable by its manifold and great advantages. Electric power is transmitted easily and with but small losses even into places where it would be impossible to haul the coal for running a steam engine. The conductors are readily placed and the energy losses in them are not large.

Motor-driven machinery is easy to operate, is of high efficiency, and runs with great reliability and with very little attention. The central power station may be placed in the most advantageous position for economical running. The motors do not consume any energy when the machines they serve are at rest, and demand little expenditure of time or material for cleaning and lubrication. Finally, the total number of employees may be considerably reduced.

FIG. 2. HERMETICALLY SEALED MINING MOTOR. THE HELIOS COMPANY.

In progress in the application of electricity to mining the various countries of Europe are however by no means on an equality. Germany is far in the lead, and German manufactures predominate. Simens & Halske have so to speak invaded all markets for electric mining machinery. By skillful appeal, by the most scrupulous care given to the construction of their mining machinery and the reliability of the material turned out, they have gained this lead. Electric applications in the German mines are numbered by the hundreds, and the majority have been installed by Siemens & Halske; the remainder of the work has been divided among several companies, the Helios having put in half a score of installations, and Schükert, the Allgemeine, and the Union, ten or fifteen each.

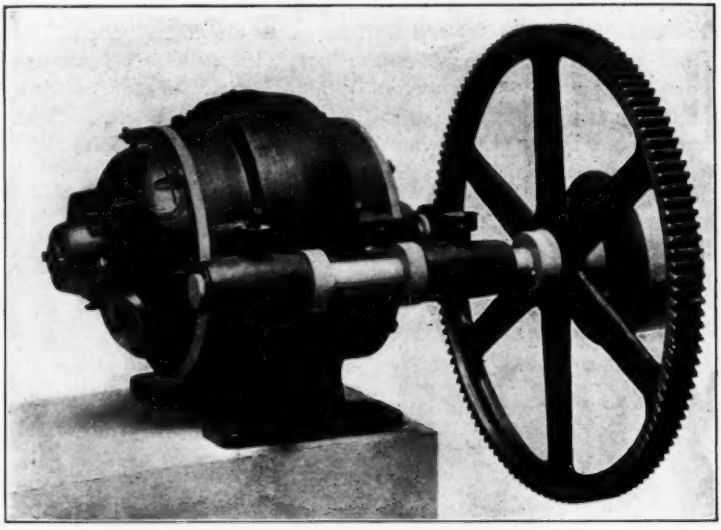


FIG. 3. GEARED MOTOR, BRIOSCHI, FINZI & CO.

In Austria-Hungary, a country rich in mineral deposits, the electric installations for mining work are almost as many as in Germany but in very few instances as important. Most of them are by Ganz, of Buda-Pesth, whose work at home and abroad comprises the equipment of some fifty electric mining plants.

England, with its many mines, would naturally be expected to show a large development of the use of electric appliances in mining. It does not, however, display the expansion in this direction one would anticipate. Most of the work of this character done by English firms has been for the South African gold mines. In Belgium also, though the mining industry is a large and important one, the use of electricity has only just begun to spread. Switzerland, a small country with but few mines, offers little opportunity; yet a Swiss firm—the Oerlikon—has put in some very important work in this line, if not at home at least abroad.

The other Continental countries are all dependent upon outside sources for their electric mining equipment. In Italy the little that has been done in this field has been done almost entirely by foreign houses. France owes her existing installations to the Thomson-Houston, the Oerlikon, and possibly a few other outside concerns. Spain has very little electric mining machinery, and that all from foreign

sources of supply. The work in the Scandinavian countries has been done by German, or in some instances, English manufacturers; that in Russia, by German and Belgian firms.

While many Continental mines are electrically equipped, there is none, to my knowledge, which is operated throughout solely by electricity. Nevertheless every phase of work about the mine can advantageously make use of it—lighting, signalling, hoisting, drifting and stoping, ventilation, hauling and tramming, firing of shots, and the surface work and ore treatment. In all of these operations electricity is a valuable and economical auxiliary—valuable, because no other agency lends itself so well to the requirements of the mineral industry; economical, because the unavoidable losses are minimised and the means are very seldom wanting for the cheap generation of electric power at the mine. Use may be made, for instance, of a waterfall, even though several miles distant, or under other circumstances of waste gases from the furnace, or yet again, when these are lacking, of steam power. It may even be possible to use wind power, by putting up wind mills in sufficient number and of sufficient size (in Vienna they have been built of 25 horse power) with the necessary condition, of course, that some form of power storage be provided, either in the way of compressed-air reservoirs or of storage batteries. In short, the general introduction of electrically operated machinery can be nothing but advantageous to the mining industry, for electricity more than any other form of power fulfills the important requirements. Of these, the foremost is certainty of operation, for the interruption of the working of certain machinery—the mine pumps, for example—might endanger the entire mine and imperil the lives of the miners. Another matter of importance is strength and simplicity of construction of the machinery and ease of its control and management. In all these points electrical apparatus now excels.

In the choice of the type of motors to employ—whether direct- or alternating-current—both sides have their champions. The Allgemeine Elektricitäts Gesellschaft, the Union Elektricitäts Gesellschaft, and the Helios Company incline rather to the continuous-current, the Siemens & Halske and the English companies to the alternating-current type. There are good arguments on both sides. The partisans of the direct-current motor argue its smaller weight, the less number of wires (two or three, instead of three or four), the possibility of speed regulation—an important consideration in some cases, as for example in the hoists—and the fact that it permits the employment of storage batteries, either for power reserve or as buffer batteries. They urge as

objection to the triphase motor the tension drop on starting; to the monophase, its slow speed, its small capacity for overload, and its low efficiency.

To this the advocates of the triphase system answer that the voltage drop is unimportant (from 580 to 540—say 40 volts) if the power at the generating station is increased at the time of starting the motor. They urge in its favor the simplicity and strength of the motors, their lack of delicate or complicated parts, and their independence of external conditions and of fouling, which is indeed an important consideration when a motor is installed in a damp, dirty mine gallery, full of steam, coal dust, or explosive gas.

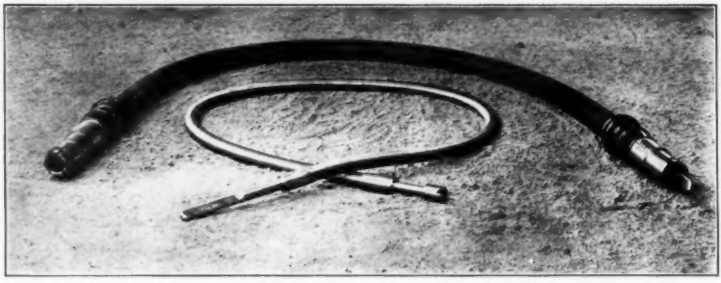


FIG. 4. FLEXIBLE SHAFT AND COVERING.

The decision depends finally on circumstances, and these circumstances, in mining, generally determine the case for the polyphase motor. The voltage of the direct current should not exceed 1,000 volts; ordinarily it is not more than 500 to 550; this is not economical for transmissions exceeding one kilometre. Alternating current, on the other hand, readily lends itself to the use of tensions as high as 10,000 volts, and at such tensions is transmitted without serious loss for distances of many kilometres. Further, it is easily stepped down to lower tension at the point of application. The advantage, in the main, therefore rests with the triphase system whenever the central generating station is far from the actual point of attack. The primary tension usually employed is 2,000 volts, the secondary or service tension being 500 volts.

To combine the advantages of both systems, certain firms—the Union Elektricitäts Gesellschaft, for example—strongly advise the combination of the alternating with the direct current, the former serving for the transmission from the central station and being transformed by a rotary into direct current at the mine.

The peculiar and very unfavourable conditions amid which a mining machine must work have compelled the development of special types of motors for this service. All the designers have sought to produce a motor—generally of the enclosed type—occupying very small space, unaffected by the surrounding asmosphere, non-sparking, non-heating even after 24 hours' continuous running, and easily taken apart and inspected. The Westinghouse Company even make a motor which, without being completely enclosed, is altogether non-sparking and runs with certainty when entirely submerged. Figure 1 shows a 25-horse-power 500-volt direct-current enclosed motor made by Brioschi, Finzi & Co. for a Sicilian mine. Figure 2 is a hermetically sealed motor for mining use made by the Helios Company.

A common difficulty in the use of electric motors for driving mining machinery is that their speed is not suited to the work in hand; the simplest, if not the best, means of overcoming it has been the use of gearing, as shown in Figure 3. The objections to this are the loss of efficiency, the space required, and the chance of breakage in the gearing, not serious, perhaps, with a small machine, but possibly a grave matter with a large one. For this reason preference is often given to belts. Sometimes the gearing is driven through a flexible shaft, like that shown in Figure 4, in which are seen the shaft and its covering. In place of these mechanical methods of speed reduction, electric means may be employed, either in the form of resistances or the application of counter electromotive force. Ordinarily the regulation is by a con-

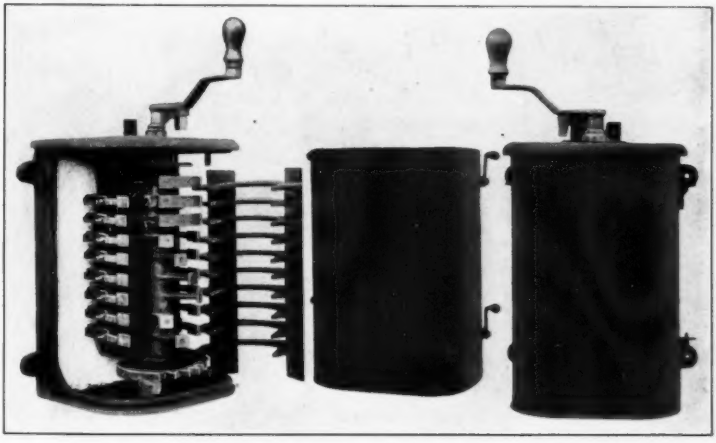


FIG. 5. CONTROLLER FOR MINE MOTOR. THE HELIOS COMPANY.

troller identical with those used with electric railway motors, as may be seen in the example by the Helios Company shown in Figure 5.

Where a motor must be moved from time to time, as for instance at the breast of an advancing gallery, the necessity of repeated lengthenings of the cables is avoided by the use of the arrangement shown in Figure 6; the cable is rolled on a reel, and uncoiled gradually as the advance of the motor requires. Continuous connection with the central station is thus maintained.

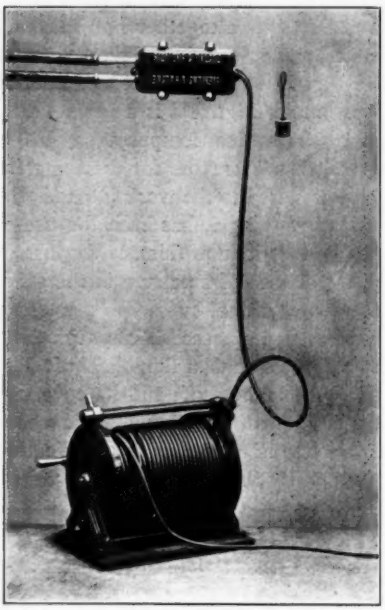


FIG. 6. CONDUCTING CABLE AND REEL.

The central power plant of a mining installation differs little from one designed for electric lighting or electric traction. Figures 7 and 8 show two interesting examples built by different electric companies. Figure 7 is the interior of the Union colliery at Zwickau, the installation having been made by Schückert & Co., of Nuremberg. There are two vertical steam engines of 700 horse power each, direct-coupled to two triphase alternators of 475 kilowatts at 2,100 volts. The engraving shows one of the main groups and the asynchronous motor driving the direct-current exciter.

In the electric power station of the Monterrad mine at Firminy, built and installed by the Oerlikon works, the prime mover is a horizontal steam engine of 300 horse power at 100 revolutions and a steam pressure of 103 pounds per square inch. This is connected to the dynamo by a Zoddel coupling. The generator furnishes triphase current at 1,000 volts, 20 periods per second. It has 24 poles; the diameter of the pole ring is 2.492 metres, and that of the interior of the armature 2.500 metres.

Figure 8 shows another type of installation, furnished to the Scharnhorst mines by the Helios Company, of Cologne. There are two alternators giving 300 kilowatts at 500 volts with 150 revolutions.

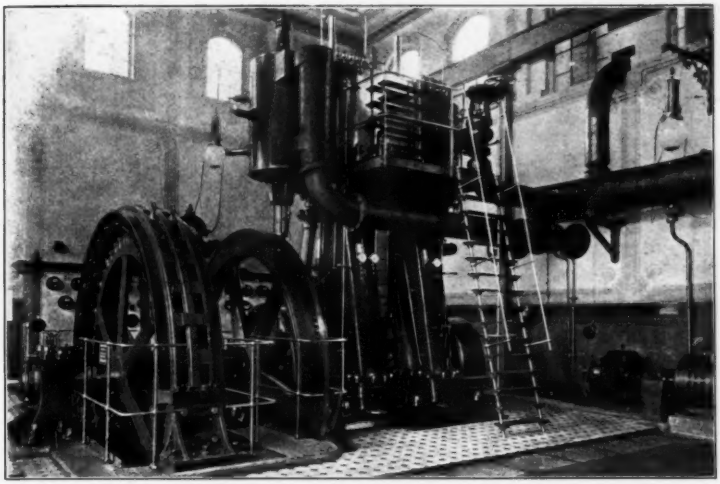


FIG. 7. POWER STATION OF THE UNION COLLIERY, ZWICKAU.

The distributing switchboard is usually placed in the central station, and where high-tension current is generated the high-tension connections are placed, for safety, on the back of the switchboard and quite out of the way of the low-tension apparatus. This arrangement is ex-

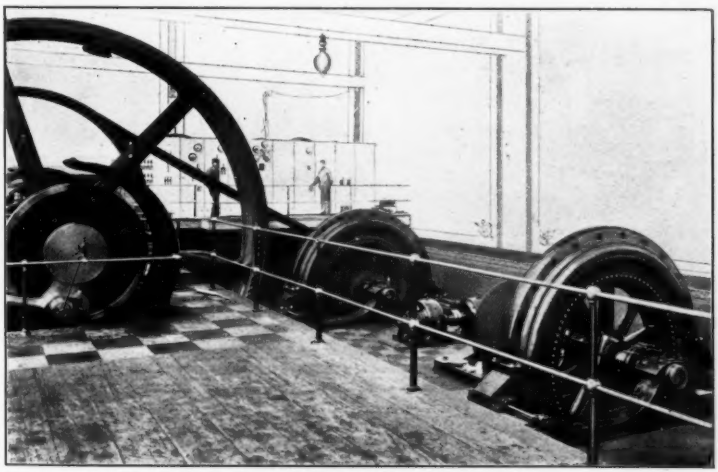


FIG. 8. POWER STATION, SCHARNHORST MINES.

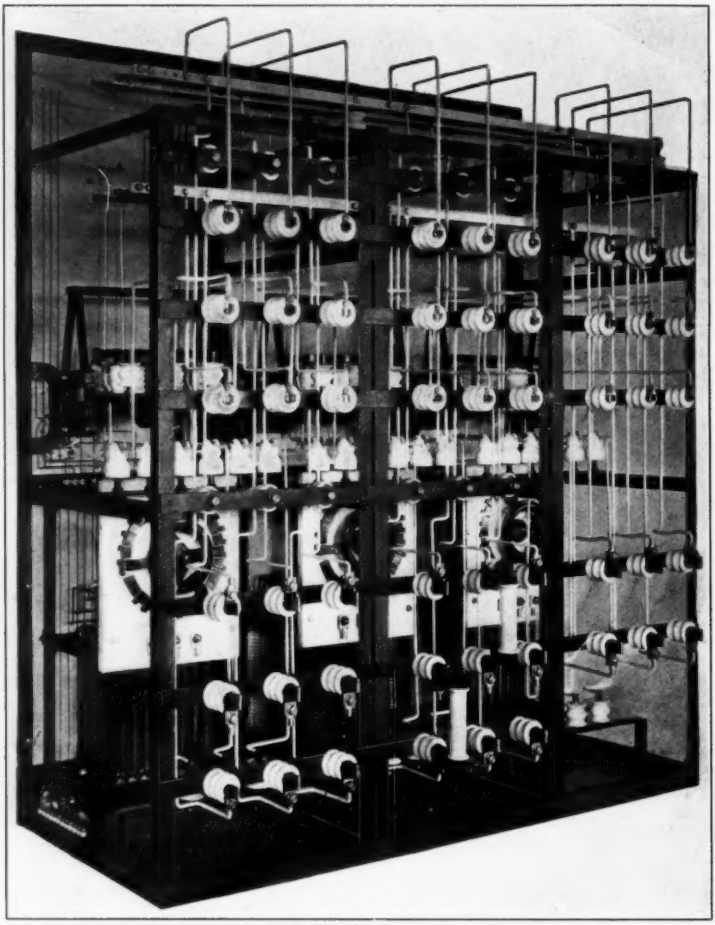


FIG. 9. BACK OF SWITCHBOARD INSTALLED BY THE HELIOS COMPANY AT THE GNEISENAU MINES.

hibited in Figure 9. It is arranged for three couples of dynamos and 2,400-volt current. The "distributing column" shown in Figure 10 is designed by the Helios Company to avoid the crowding and concealment of part of the apparatus which sometimes constitutes a disadvantage in the ordinary switchboard.

As in the case of the power plant, the lighting installation of a

mine exhibits no special features. Arc lamps and incandescent lamps are both in use, the former particularly for the surface workings, as seen in Figure 11, which represents the headworks of a mine equipped by the Union Elektricitäts Gesellschaft. In other cases incandescent lights only are used, as in the Gottessegen mine at Zwick, where the Schückert Company installed 120 incandescent lamps on the surface and 30 in the underground workings. At the Beth mines of the Società Mineraria Italiana, the ore-treatment plant and the quarters in the valley of Chisone are lighted by continuous current at 110 volts supplied by the exciter dynamo; the buildings at the principal mine entrance, at an elevation of 2,700 metres, are lighted by triphase current stepped down from 2,000 volts to 210 volts. For the miners' portable lamps it is the practice to use storage batteries, on account of the difficulty which would be experienced in taking current from aerial conductors. In order to diminish the frequency of the necessary recharging, lamps of low wattage are preferably employed. The light is thus much less intense, and the consumption of current smaller.

FIG. 10. SWITCHBOARD COLUMN.

If electric lighting of the mine and its adjuncts

FIG. 11. SURFACE PLANT LIGHTED BY ARC LAMPS.

FIG. 12. SIGNALLING SYSTEM, GLÜCKAUF MINE, SONDERSHAUSEN.

has received less attention than it merits, telegraphy and telephony as applied to this special service have received much attention from inventors. Three points especially have been subjects of study—certainty of operation, resistance to damp and to dust, and protection

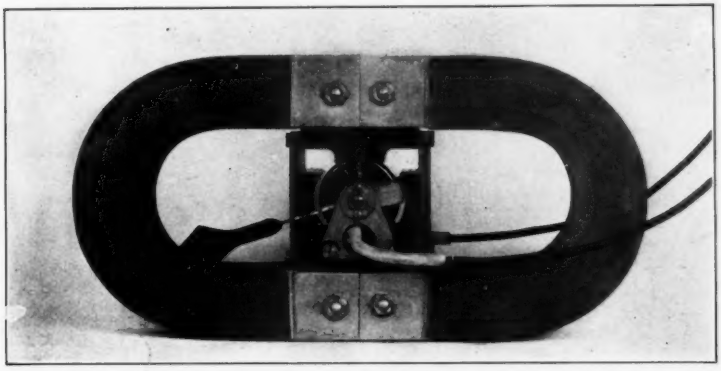


FIG. 13. MAGNETO RECEIVER FOR MINE SIGNALLING, UNION ELEKTRICITÄTS GESELLSCHAFT.

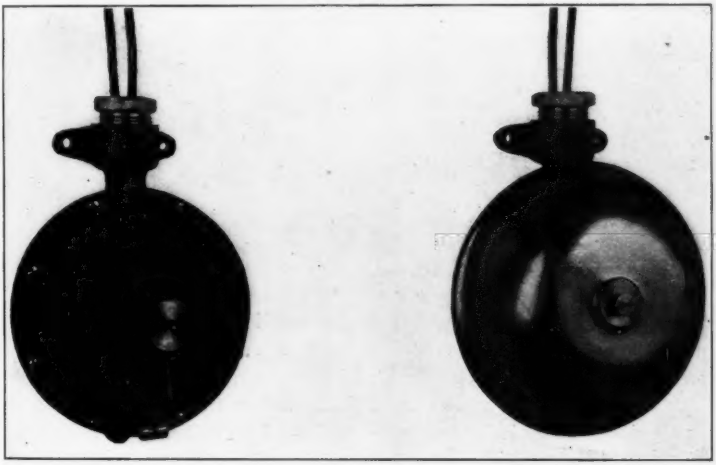


FIG. 14. ENCLOSED MINE CALL BELL.

from mechanical injury. Some manufacturers also have provided apparatus for currents of high intensity.

In the telegraphic systems, each station is usually provided with a transmitter and a receiver. The receiver commonly consists of a volt-

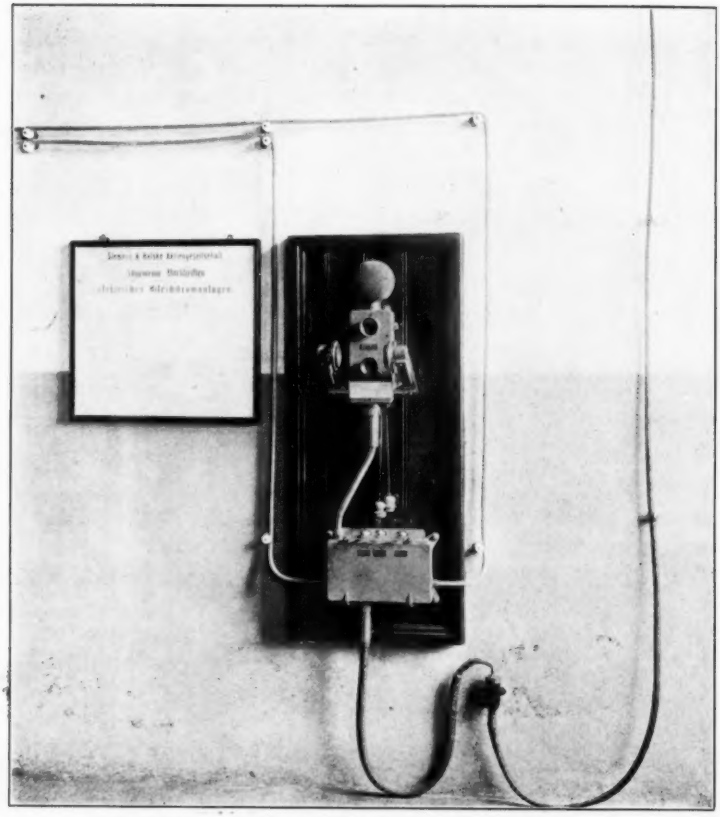


FIG. 15. SIEMENS & HALSKE MINE TELEPHONE.

meter around the dial of which are arranged a number of signals or orders. The operator transmitting the order turns the crank of a magneto machine until the needle of the transmitter dial reaches the signal desired. The same signal is indicated on the receiver dial, and usually is accompanied by as many strokes of the bell as the needle has advanced degrees. The operator receiving the signal repeats it back to the sender, who is thus assured that it has been correctly understood. Figure 13 shows the magnetic receiving system for mine signalling as installed by the Union Elektricitäts Gesellschaft. By virtues of a special form of the poles, the deviation is about 220 degrees. A small dial and a short needle permit the transmission of quite a large number of

signals. Both transmitter and receiver, it is needless to say, are completely encased and impervious to dampness or dust. This is true also of the telephone apparatus, usually loud-speaking, the receivers and transmitters proper being customarily closed by rubber stops. When placed in very noisy situations, the telephones are usually provided with movable receiver tubes which the hearer turns forward and adjust to the ears. An installation of this type is shown in the illustration Fig. 15 on the opposite page. A series of push buttons serves to put the telephone in circuit with the various lines.

A great deal of the mine signalling may be done by simple sounders. Such is the case with the signalling connected with the mine haulage, to notify the operator at the winding engine or motor when a car has been hooked on, or if it is derailed, etc. For this service two bare wires are run from the signal bell at the hauling engine through the gallery where the trams run. A piece of metal of any sort serves to complete the circuit at any point. Mine call bells are operated by either direct or alternating current, and in the latter case they are often worked by magneto-electric machines identical with those used for the firing of blasts. They are built for currents from 6 to 110 volts. They are completely and hermetically enclosed, as shown in the example in Figure 14, representing a call bell made by the Union Elektricitäts Gesellschaft; on the left the bell is removed. Figure 12 is a signalling system put in by the Siemens & Halske Company in the Glückauf mine at Sondershausen. The view is taken at the bottom of the mine; at the back, to the right of the entrance to the shaft, is a closet containing a magneto

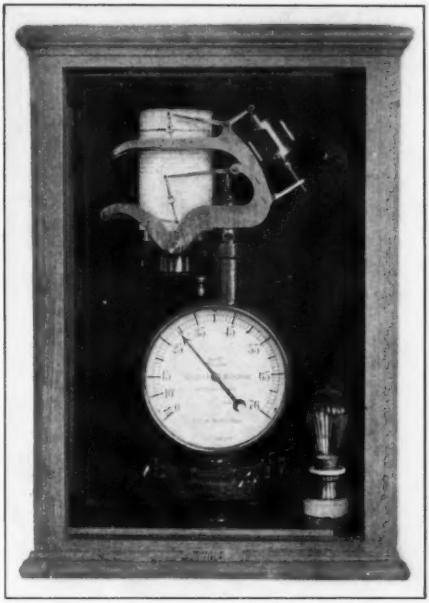
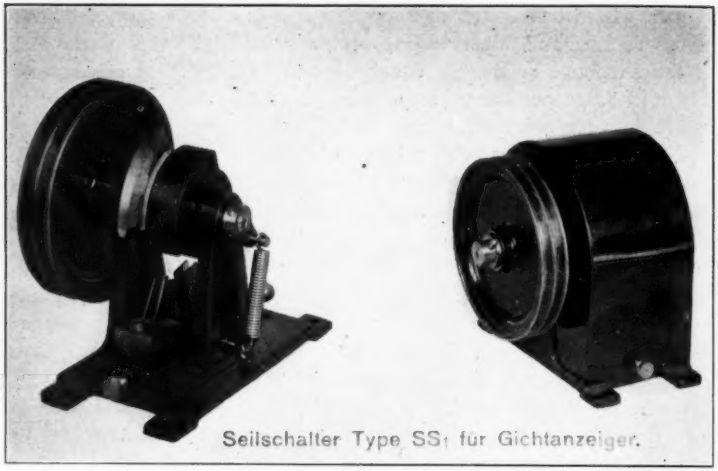


FIG. 16. REGISTERING SUMP GAUGE.
Union Elektricitäts Gesellschaft.



ROPE-ACTUATED SWITCH FOR SUMP GAUGE.

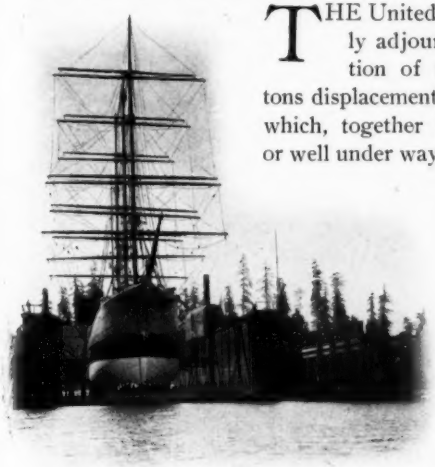
and sounder. The electric transmission of signals has the advantages of promoting safety, of permitting the rapid transmission of orders, and of establishing a bond between the various parts of the mine and the office of the mine manager. Other electric apparatus —revolution counters, gauges of the depth of water in the sumps, wagon counters, etc., serve further to keep constantly in view in the office the general progress of the work everywhere in the mine.

The secondary applications of electricity to mining, it will be apparent, are of much importance; but far more so are the primary applications, as we shall see in a succeeding article.

DEVELOPMENT IN FLOATING DRY-DOCKS.

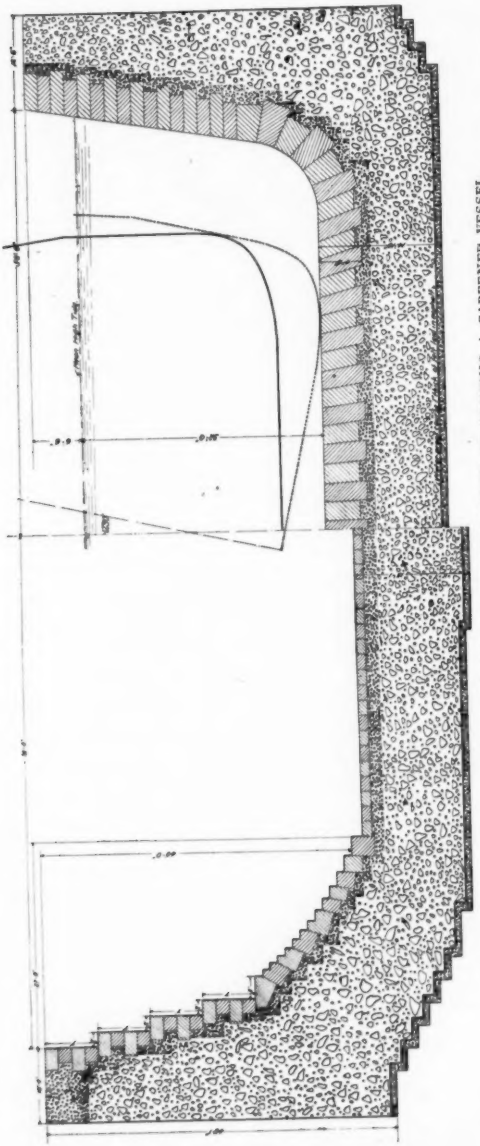
By Joseph J. Shultz.

The importance of adequate docking facilities to commercial expansion—to say nothing of the very vital question of their essentiality to naval defence—was emphasized in this Magazine by Mr. Foster Crowell in a series of papers published in 1897. Mr. James McKechnie, in his admirable review of British ship-building which appeared in our pages early in 1898, referred to the dry-docks of the United Kingdom as a very important factor in the expansion of Britain's marine interests. Mr. Schultz's article is specially significant in showing how effectively the marine architect and naval constructor have come to the aid of the civil engineer in affording a readier answer to this pressing problem.—The Editors.



THE United States Congress that has lately adjourned authorized the construction of three battle-ships of 16,000-tons displacement each, and two of 13,000-tons which, together with the ten just completed or well under way, will enable the United States to hold its position of third as regards tonnage among the world's naval powers. These are large additions, but the new demands laid upon the navy in providing adequate protection to a greatly extended territory and in maintaining properly a world-power dignity justify them. The fact, however, must not be lost sight of that, unless the facilities for keeping these fighting machines in the highest possible state of repair and efficiency are commensurately increased, the new vessels themselves will be of no more value than if at the bottom of the Pacific Ocean.

The only means of thoroughly overhauling a vessel is by placing it in a dry-dock where its sides and bottom are entirely exposed and where its equipment may be carefully examined; and, in Europe and America as well, docks have hitherto been almost exclusively of the "graving" type—excavations made in earth or rock and lined with



SECTION OF GRAVING DOCK, SUGGESTING THE DIFFICULTY OF DOCKING A CAREENED VESSEL.

masonry, timber, or concrete, and closed at the entrance end by a removable gate or caisson. These have served their purpose admirably, but they cannot fulfill the exigencies created by modern naval and maritime development.

The following comparison gives the relative advantages of this type of dock and its successor, the steel floating dry-dock.

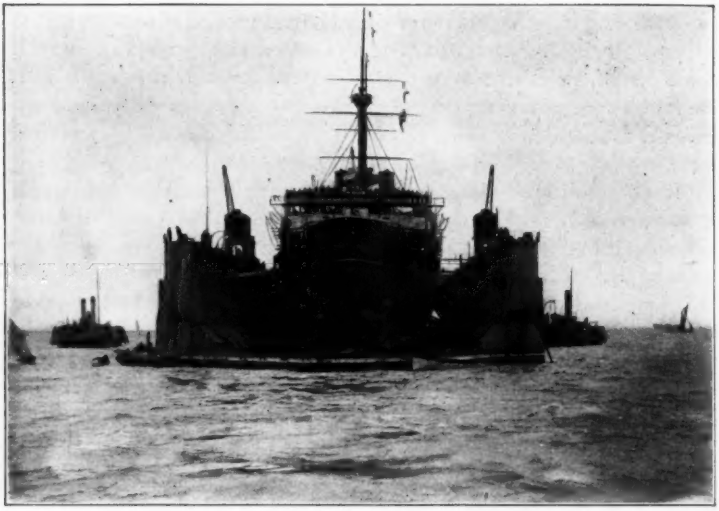
The Connecticut may be taken as a type of the modern battleship. This is 450 feet in length, of 77 feet beam, has a draft of 27 feet and a displacement of 16,000 tons; but some of the auxiliary cruisers, which on account of their speed are of the greatest importance in time of war, are 600 feel long; and therefore a dry-dock capable of accommodating any naval vessel with ample light and room for making the repairs must be at least 750 feet in length, 100 feet

in width, and have a clear depth over the entrance of at least 32 feet at mean high tide. Several naval docks now under construction fulfil these conditions except as to length, and the longest is only 600 feet. Be it observed, however, that the above docks will accommodate such a vessel as the Connecticut only under perfect conditions, i. e., normal displacement, even keel, and high tide.

In peaceful times such conditions are easily obtainable, but during a war a vessel may be crippled, and still float, to the extent of being submerged five or six feet below its mean displacement line, and have a list of 20° or 25°, which on account of the perfectly flat keel would still further increase its draught five feet and add very materially to its beam as is shown by the mid-ship section of the Connecticut in Figure 1. This would debar the vessel absolutely from every dry-dock in the world, and therefore compel its abandonment simply from the lack of proper docking facilities. It is also seen from Figure 1, that a list of only 12½° at normal displacement would prevent the vessel from entering the largest dock in the United States. This condition is one that is very likely to occur in a naval engagement, and the necessity for providing means for docking such vessels is self-evident.

A glance at the accompanying cross sections through the body and entrance of a graving dock with 32-feet clearance at mean high water will show that further increase in depth is prohibited on account of the immense addition of masonry that would have to be made in order to withstand the added pressure on the sides and at the caisson seat. No such obstacle, however, stands in the way of building a floating dock to meet these conditions. In a graving dock the walls and sides must be designed not only to withstand the water and earth pressure upon them, but to provide sufficient dead weight to balance the entire amount of water displaced by the dock, while the sides and bottom of a similar floating structure need have only sufficient lateral and longitudinal stability to sustain the actual weight of the vessel; the walls do not take one pound of water pressure, and the bottom only that due to the combined actual weights of the dock and vessel. There is therefore no prohibitive depth in the construction of a floating dock—for with a given lifting capacity, to obtain an increased draft over the keel blocks, the bottom remains exactly the same and only a corresponding increase is necessary to be made in the height of the sides, thus securing by the greater girder depth a stronger and more rigid structure than before.

From the standpoint of necessary depth, therefore, the floating dock is the only resort, and it posseses as great an advantage over the

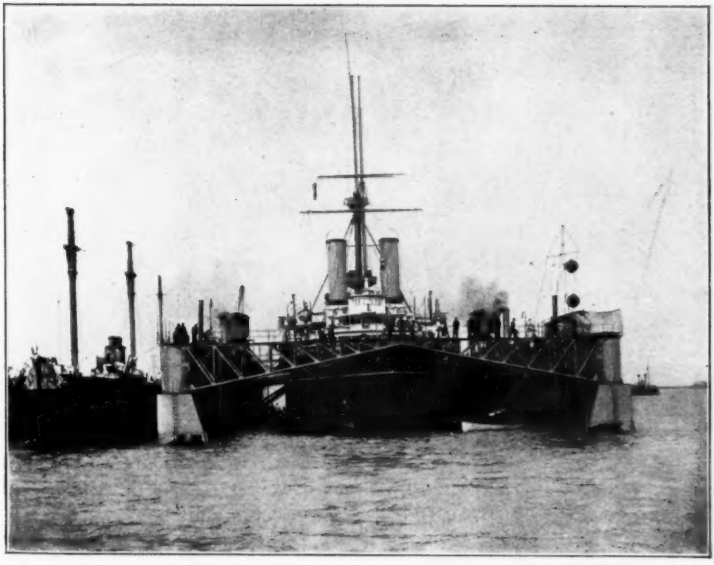


THE BERMUDA FLOATING DOCK LIFTING H. M. S. SANS PAREIL.
Built by Swan & Hunter, Wallsend, Newcastle-on-Tyne.

graving dock in point of length. It is a significant fact that, until the completion of the 700-foot floating dock by the Morse Shipbuilding Company, there was not an American ship-yard where the longest Atlantic liners could be safely docked. This contracted length of the commercial graving docks is due to the fact that they must be built nearly normal to the water front and wholly in solid ground, and the depth of the yard, limited by the enormous value of water-front property, is insufficient to contain longer ones. A floating dock, however, can jut out into the water to the harbor commissioner's line and its limitations in length are, therefore, only those determining the dimensions of the ship; for if a vessel can be constructed of sufficient rigidity to withstand the rigors of a stormy Atlantic passage, a floating dock operating in still waters and subjected to static loads only can certainly be built long enough to lift that vessel safely.

Consider further, however, that repairs on a vessel damaged as above, to be effective, must be made at once—one cannot wait for a high tide or to tow it a long distance. Therefore a third advantage is the ready accessibility of a floating dry-dock. The condition of the tide does not affect its clearance over the keel blocks and the site is not dependent upon the character of the ground. The best location for

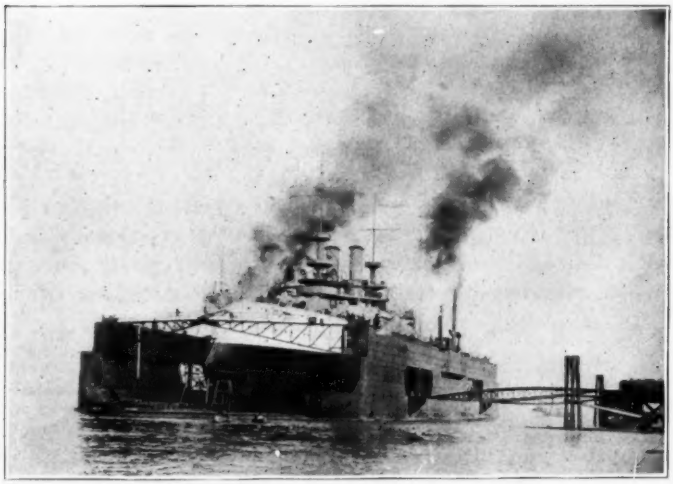
a graving dock is one where the foundations are of stiff clay, gravel, or rock, and although docks of this type can be and are built upon piles in some soft foundations, yet it is impossible to construct them in ground where there is an excessive amount of quicksand or where springs are likely to be met with. The dangers of the latter are exemplified by a New York dock, on which $200,000 has been expended for repairs to the bottom and the dock is at present almost worthless although of the best masonry and completed only a few years ago. On the other hand, a floating dock can be located anywhere there is sufficient depth of water to allow its sinking deep enough to take on the vessel. Further than this, in a war the floating docks could be towed to those points which are likely to be most accessible to the naval operations, and if necessary a dock could even be taken out to meet a damaged incoming vessel which could be docked in the open sea as soon as overtaken—a feat that has been accomplished several times. Repairs could thus be made quickly enough to save the vessel and allow it to go again into action; and it is very probable that most, if not all, of Spain's ill-fated Cuban fleet could have been saved for the American navy had a floating dry-dock been towed to the immediate vicinity,



H. M. S. SANS PAREIL IN THE BERMUDA DOCK, PARTLY SUBMERGED.

thus permitting them to be quickly moved into it, and temporarily repaired.

In regard to the time required for construction the floating dock also has a very great advantage. Borings may be taken on the site selected for a masonry dock, test piles driven, and the range of the tide gauged. With these data the plans are gotten out, but the greatest difficulties are by no means overcome. The condition of the ground fifty or sixty feet below the surface is not definitely known.



DOCKING THE BATTLESHIP "ILLINOIS" IN THE FLOATING DRY-DOCK AT THE U. S. NAVAL STATION, NEW ORLEANS, LA., JANUARY, 1902.

Built by the Maryland Steel Company.

Springs may be encountered and an expensive and troublesome coffer dam must be maintained across the entrance until the structure is absolutely completed. Consider for example the masonry dry-dock at Boston, Massachusetts. Congress made the appropriation on May 4, 1898; the contract was let on March 4, 1899, but at the present time there is little more than a hole to mark the site and the dock will not be wholly finished for two years more. The same is more or less true of the other three naval docks provided for at that time, while in contrast with this take the floating dock authorized by the same Congress for Algiers, La., the first large structure of its kind provided for by the United States. This has a capacity equal to any of the docks just mentioned and the time elapsing between the signing

of the contract and the completion of the dock at the yards of the Maryland Steel Co. was only thirty months, and since January 6, 1902, the dock has been in active operation on the site in Louisiana.

Although an actual comparison of the cost is rather difficult, it may be examined from these standpoints:

First, original cost. For a floating dock the cost of the site is practically eliminated and a suitable berth is all that is necessary. In a graving dock the machinery plant must include the necessary power for operating the caisson and a pumping plant of sufficient capacity to empty the entire contents of the dock, while in a floating dock the entire machinery consists of the valves for controlling the flow of water through the various bulkheads and compartments, and

FLOATING DOCK FOR LOANDA, IN PORTUGUESE AFRICA.

Built in 1896 by A. F. Smulders, Rotterdam.

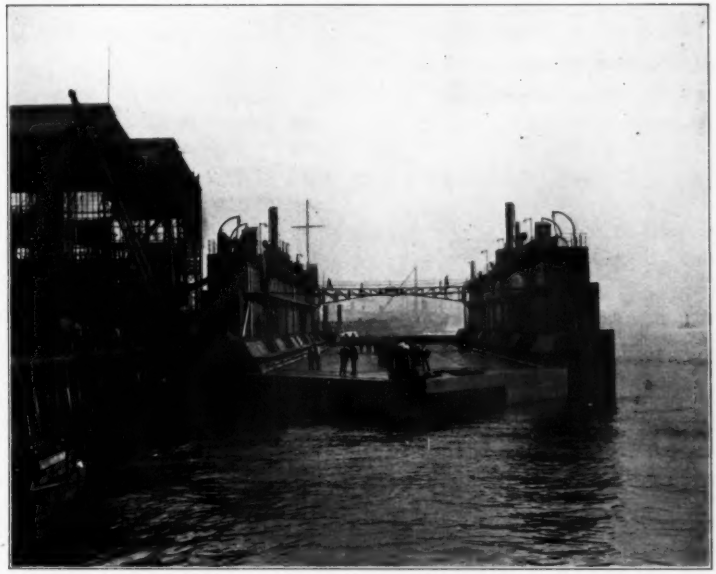
the pumps for removing an amount of water equal to the weight of the docked ship plus that of the dock—in quantity only one-tenth or one-twelfth as large as the above. A saving in two instances is therefore effected. A comparison of the cost of the masonry or timber and the steel cannot be definite, but the masonry will be about twice as expensive as the steel under the present ratio of prices, and timber

about the same price. But most important of all is the fact that a floating steel dock can be built for the estimated cost, while one of the graving type, owing to the large factor of uncertainty attending its construction, almost invariably exceeds the original estimate. The cost of the Toulon masonry dock, which has a working length of 600 feet, was $1,065,000 and the machinery equipment $400,000; the new dry-dock at Charleston, S. C., is to be 575 feet long, of concrete lined with granite, and will cost $1,500,000 complete; the new Skinner timber dock at Baltimore, 650 feet long, cost $700,000, while the floating dry-dock at Algiers—which is capable of taking every vessel accommodated by the above docks—cost complete $810,000 and the new 18,000 ton dock will be built and towed to Cavite for $1,200,000. A graving dock of like capacity would have to be 750 feet long, costing at least $3,000,000 complete at that remote place.

Second, operating expenses. These will be much lower, probably only one-fourth, for the floating dock, because there is far less water to handle and no caisson to operate.

Third, cost of repairs. Of course a floating dock, being entirely of steel, must be given constant attention as regards cleaning and painting; but 1 per cent. per annum of the original cost will cover

THE LOANDA FLOATING DOCK, COMPLETE.



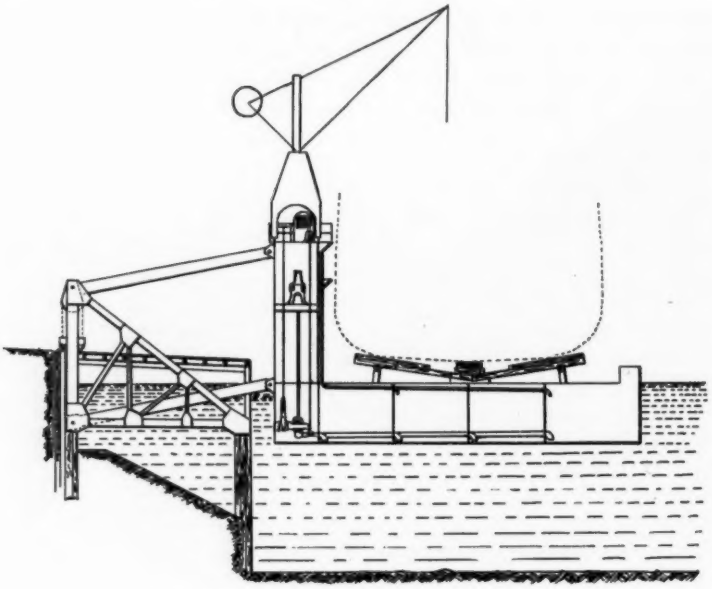
THE DURBAN FLOATING DOCK AT THE BUILDERS' WORKS.

Swan & Hunter, Newcastle-on-Tyne.

these, and it is doubtful whether a masonry dock can be properly maintained at a lower cost, while the necessary repairs to a timber dock will amount to at least twice as much.

From the standpoint of durability the masonry dock apparently has the advantage, but this is only true of graving docks constructed in absolutely solid rock; for under other conditions, even with extreme care in building, their life will scarcely exceed seventy-five years. Consider, however, that there are now in excellent condition several floating docks that have operated continuously for over forty years, and this in the face of the fact that they were the pioneers of their kind. Therefore, with the knowledge gained by the experience of forty years, a floating dock can certainly be built and cared for so as to last at least the same time as the graving dock, and in comparison with the timber dock, which is invariably the type of present American commercial docks, it is safe to say the steel dock will outlast three of them.

In these important points, therefore, floating dry-docks far outclass those of the graving type, and this superiority has been recog-



SECTION THROUGH OFF-SHORE DOCK.

nized for more than a century, although such structures could not be built with sufficient longitudinal and lateral rigidity until iron and steel had replaced wood as the materials of construction.

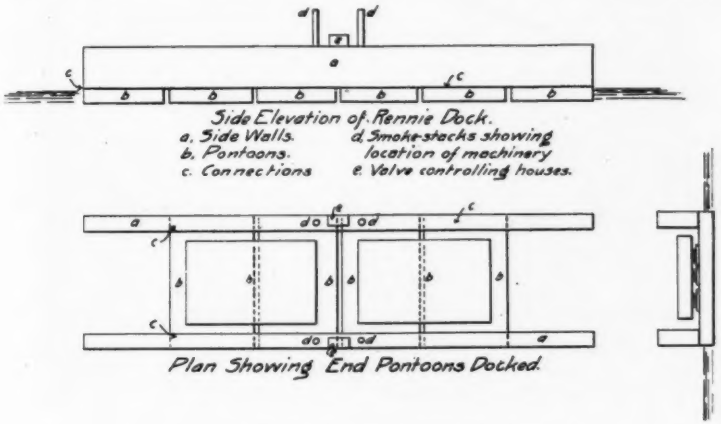
The first docks of the floating type were built early in the last century and were called depositing docks, consisting of one side only from which projected large teeth upon which the vessel rested while being raised. When clear of the water the dock was floated to an adjacent stationary structure into which the teeth fitted and upon which the vessel was deposited as the dock was allowed to sink. A large number of these were constructed and some are still in use by the Russian and Spanish Governments.

As a logical successor to this, came the "off-shore" dock shown just above. As regards buoyancy this dock is self-contained, but its stability is secured through the shore connections indicated. Such a dock is particularly well adapted to places where economy of space is an important factor, for the vessel is docked from the side and the large amount of dead space required for end docking is eliminated; they are therefore much used in England and Germany's crowded ship-yards—the largest being that at Hamburg, which is 85 feet

wide, 320 feet long, of 5,000 tons capacity, and connected to the shore by ten columns.

The double-sided dock, however, is the only type adapted to handling the heaviest class of vessels, because both sides are required to secure the rigidity necessary to prevent a deflection that would be injurious to the contained ship.

Modern docks of this class were used in the United States as early as 1837, but the honor of building the first successful double-sided floating dock entirely of iron belongs to an Englishman, George P. Rennie, who in 1857 designed and constructed one for Carthagena, Spain. This is 320 feet long, 79 feet wide inside, 48 feet high outside, and has a draught of 24 feet 6 inches over the keel blocks, and a capacity of 6,000 tons. As a test, immediately after completion, the Numancia, a ship weighing 5,600 tons, was docked in it and kept on the blocks for 80 days without any defect being discovered, and the dock is in excellent working order at the present time. Mr. Rennie also first demonstrated that the present ⊔ shaped cross section is the most economical and at the same time the most stable section for structures of this character. His docks consist of continuous side

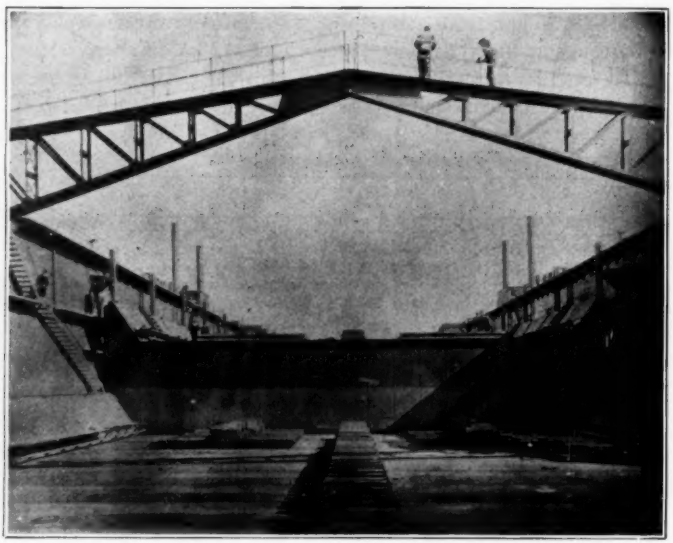


ELEVATION, PLAN, AND SECTION OF RENNIE DOCK.

walls supported upon and securely bolted to a number of pontoons which furnish the structure's buoyancy—the entire rigidity being imparted by the walls. His design also marked a step in advance, in that these pontoons were removable and could be self-docked, and thus repaired.

This is one of the most important features of a floating dry-dock, for the life of the structure depends upon the thoroughness with which repairs are made to the under-water portion. On page 683 there is given a general side elevation of the Rennie type of dock and the plan shows the two end pontoons self-docked. This operation is very easily accomplished, for it consists simply in sinking the dock a little way, unbolting the fastenings of a pontoon, floating it from under the side walls, and then further sinking the dock sufficiently to allow the pontoons to take the blocks, when all necessary painting and repairs can be made.

A number of docks have been constructed upon this plan, the largest being that built for Messrs. Blohm & Voss at Hamburg, which has a capacity of 18,000 tons exclusive of its own weight. Several were built from 1865 to 1890 with slight modifications—the most im-

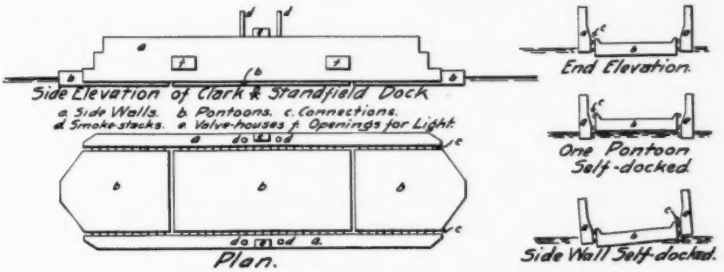


SELF-DOCKING THE MIDDLE PONTOON OF THE NEW ORLEANS FLOATING DRY-DOCK.

portant of the latter class being that designed by Tramwell in 1867, for St. Thomas, Danish West Indies. This was open-sided, part iron and part wood construction, and though in use today is very clumsy to manipulate in docking a vessel and in self-docking its own pontoons.

About 1896 Messrs. Clark and Standfield, an English firm, who

had hitherto designed docks of the depositing and the off-shore type, patented a kind of floating dry-dock which differed from the Rennie dock in that the side walls were not supported upon the pontoons but were fastened to their ends, and the self-docking was accomplished by raising the pontoon a small distance vertically. The Algiers dry


Side Elevation of Clark & Standfield Dock
a Side Walls. b Pontoons. c Connections.
d Smoke-stacks. e Valve-houses f Openings for Light
Plan.
End Elevation.
One Pontoon Self-docked
Side Wall Self-docked.

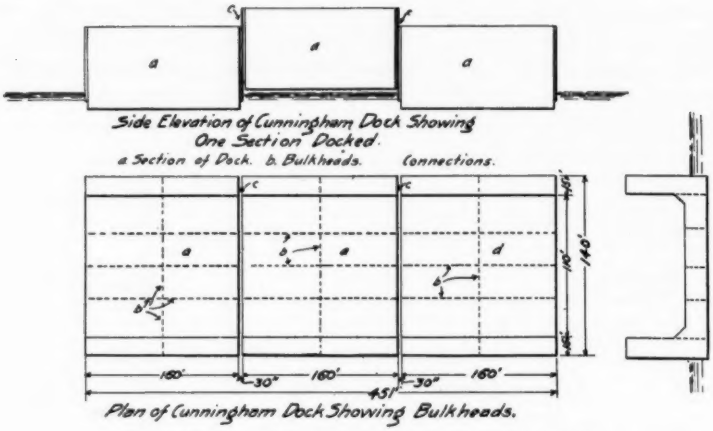
ELEVATION, PLAN, AND SECTIONS OF CLARK & STANDFIELD DOCK.

dock is of this class and the longitudinal and transverse elevations in this page indicate the general construction, while page 684 shows one on the pontoons self-docked, and the illustration on page 678, the U. S. S. Illinois in dock. Since 1897 this firm has designed four other docks of 12,000-tons capacity.

It remained, however for an American inventor, Lieutenant Andrew C. Cunningham, Corps of Civil Engineers, United States Navy, to design and patent in 1902, a floating dry-dock introducing new features that will expand the field of usefulness of these structures. The general characteristics of this new type are shown in Figures 8 and 9, and while no docks of this design have been constructed the United States Navy Department recently awarded a contract for the new 18,000-ton floating dry-dock for the Philippines on a bid upon a dock of the Cunningham type.

Essentially this dock is composed of several sections, each of which is a complete dock in itself; and the walls and bottom of each section are continuous, thus securing the strongest and most rigid construction with the least amount of metal. The connections between the several sections are ordinarily above water and are so located as easily to be made stronger than the walls themselves. One form of fastening proposed by Lieutenant Cunningham is shown in Figure 10 and consists of 6 feet by 6 inch angles fastened together by plain 2 inch bolts.

In the Cunningham dock the self-docking of the sides and bottom is



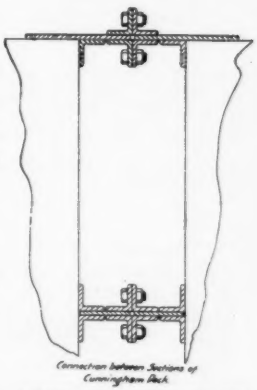
ELEVATION, PLAN, AND SECTION OF CUNNINGHAM DOCK.

accomplished at one operation while in the others two or more are necessary. The method is: The several sections are pumped to an approximately even keel; the bolts of the part to be docked are loosened and removed, and the remaining sections allowed to sink partially—the loose section being guided vertically by the bolts through the slotted holes in the connection angles. The sections are then reconnected and the two end portions pumped out, thus bringing the docked section to any height desired above the water.

The section adopted does not involve the use of any unusual shapes and it is possible to construct the entire dock by employing only the ordinarily rolled commercial steel sections. This not only reduces the cost but facilitates construction and cuts down the time for completion to a minimum.

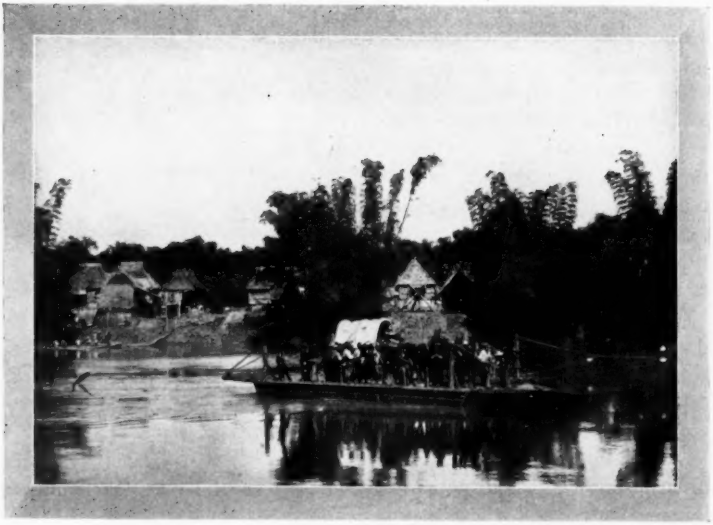
Since the dock is composed of independent sections, its length may be adapted to the ship which is docked and a great saving in operating expenses can hence be secured. But of far more importance is the fact that in docking short heavy ships, the cantilever ends of the dock, extending beyond the ends of the vessel, which are so frequently strained injuriously in the Rennie and Clark docks because they do not have the same lifting power as the remaining portions, are left off; and the entire length used, (which is only that necessary to develop the requisite buoyancy), is then subjected to the same stress and the deflection reduced to a minimum. From a naval standpoint the division into several sections is very desirable, for the various

parts may be distributed in time of peace among a number of naval stations, and in case of war they can be quickly towed to a common place for assembling and docking the largest vessel. From a commercial standpoint they are even more valuable, for by providing a reasonable beam and draft a small capacity can be started with and this increased as larger patronage is obtained, finally securing a dock capable of taking the largest liners and at the same time very easily divided to dock several small vessels.



CONNECTION BETWEEN SECTIONS OF CUNNINGHAM DOCK.

With the possibilities afforded by docks of the floating type, therefore, a large number of commercial dry-docks can be built and thus remove one of the chief hindrances to the development of American shipping—the great lack of repairing facilities in American ship-yards—and there can also be provided on every one of the American island possessions, and at other convenient points on the sea-coast, good, complete repairing plants for the Navy and thus make it as strong in time of war, when quick repairs are of as great value as ships, as it is in these peaceful times.



Flying Ferry near Arayat, Installed by Engineer Troops.

MILITARY ENGINEERING AND CIVIL OPPORTUNITIES IN THE PHILIPPINES.

By Captain William W. Harts.

The engineer is nowadays practically the pioneer of civilization, and has therefore a foremost interest in the knowledge of the conditions and opportunities in new countries. Captain Harts' article will appeal to the reader by the definite suggestion it makes upon these points.—THE EDITORS.

SINCE the arrival of the first American troops in the Philippines, the work of the engineers has been arduous and varied.

From the first march of the American troops from Cavite to Manila, when the city was captured, up to the present, they have been busily engaged with whatever problems their training could solve. On this first march, they removed the Spanish and insurrecto trenches from the line of march of the army, reconnoitered the positions of the enemy, prepared bridges and fords, and even took a share in the attack on the place. Later, when the Filipinos became hostile and attacked

the American lines, the hasty repair of bridges destroyed by the insurrectos, laying out camps and lines of defence, constructing military roads and bridges, making surveys and supplying maps, were some of the more important duties that fell to their lot. The photographs herewith show some of the work on which they have been engaged.

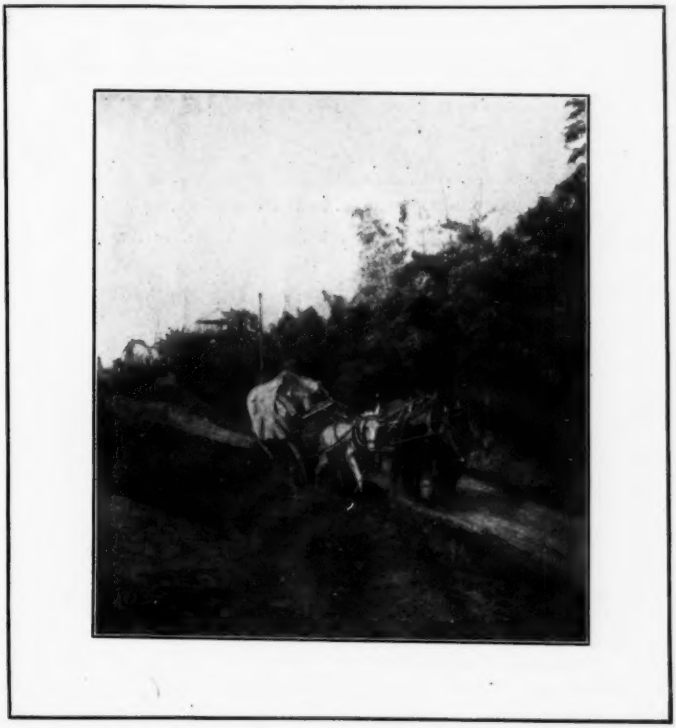
In the early days of the American occupation, the restoration of the Manila and Dagupan Railway was an important work, as the first advance northward was made along this line and the road had to be used as a line of supply. This road had been badly wrecked by the insurgents, and in several instances bridges had been wrecked by dynamite and rolling stock purposely piled up in a mass of debris. This railway was quickly put in good condition, however, by the engineers and operated by them until finally turned over to the owners. Later the supply of the many garrisons made necessary by the wide occupation of territory made supply roads imperative. Hundreds of miles of road in the island of Luzon, alone, were repaired and made passable, also a great number of bridges were built. These roads and bridges were partly of hasty and temporary construction, but some were made durable and permanent, depending on the needs of the troops.

BRIDGE OVER AN ARM OF THE RIO GRANDE DE PAMPANGA, ONCE BURNED AND ONCE WRECKED BY INSURGENTS AND TWICE REBUILT BY THE ENGINEERS.

ROLLING STOCK OF MANILA & DAGUPAN RAILWAY, WRECKED BY INSURGENTS AT BAMBAN BRIDGE. LATER REMOVED AND PUT INTO USE BY THE ENGINEERS.

BRIDGE ON MANILA & DAGUPAN RAILWAY, DESTROYED BY INSURGENTS AND PLACED IN CONDITION FOR TEMPORARY USE BY ENGINEER TROOPS.

The road in Mindanao from the coast to Lake Lanao has been practically completed, and a feat believed impossible by the Moros has been accomplished. This has already had a very sobering effect on their warlike aspirations and will be a strong argument, easily comprehended, in case of further restlessness on their part.



BAD ROAD IN BATANGAS PROVINCE, HUB DEEP IN MUD. LATER MACADAMIZED BY THE ENGINEERS.

A finely macadamized road, about thirty-six miles long, has been built from Calamba to Batangas in the provinces of Laguna and Batangas, and another about twenty miles long in the province of Albay. Extensive road and bridge construction has been carried on in the provinces of Pangasinan, Bataan, Nueva Ecija, Pampanga, and South Camarines—in fact there are few provinces in Luzon where valuable work has not been done on the roads and lines of communication. In all, something like nine hundred miles of road have been built or im-

REBUILDING RAILWAY TRESTLE CARRIED AWAY BY A WASHOUT NEAR TARLAC.

proved in Luzon. In many cases this required the construction of extensive causeways through rice marshes.

Although excellent timber, suitable for bridge building, is to be found in most provinces, it is difficult to obtain speedy delivery at the points where needed; besides, all timber must be dressed by hand. It was therefore found expedient to import Oregon pine from America, which was largely used for bridges, many of them being constructed to standard plans in Manila and shipped, "knocked down," to the sites and there erected. In all this road and bridge work, natives were em-

CROSSING AN IMPROVISED BRIDGE NEAR MALOLOS.

ployed in large numbers and divided into squads, over each of which an engineer soldier acted as overseer. Non-commissioned officers of engineers were charged with general supervision over several squads, and all the engineer work in a single district, usually embracing several provinces, was placed in charge of an engineer lieutenant who received his orders from the engineer officer of the department. Thus a complete line of responsibility and control was arranged which has worked very satisfactorily in practice.

BRIDGE HASTILY ERECTED NEAR CAPAS BY THE ENGINEERS.

About $400,000 Mexican has been expended during the last year and a half on this work in Luzon.

In most places, suitable rock has been very scarce, making the cost higher than elsewhere. The best results have been generally reached by placing a foundation, from eight to twelve inches thick, of "dobie" stone, which is a soft volcanic tufa and the best available in most places, and then covering this three to five inches thick with coarse river gravel and then rolling it. Such roads, sixteen feet wide, cost about $5,000 Mexican or $2,000 United States currency per mile and last as long as the top dressing is continuous and properly cared

for. A curbing of small boulders, where practicable, or else of dobie stone, is set in a shallow trench to prevent the road from spreading. When properly graded, ditched, crowned and cared for, these roads are very satisfactory. Usually extensive fills are necessary to raise the roads high enough above the surrounding rice paddies to keep them dry in the wet season.

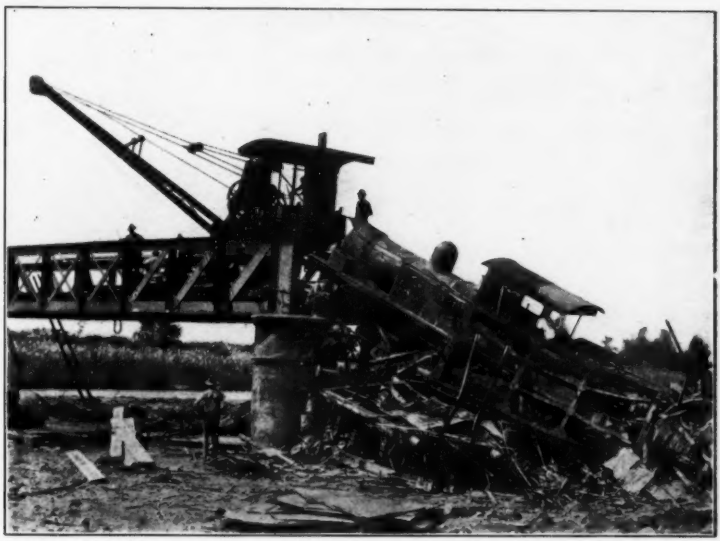
Since the islands were turned over to the civil government in July, 1902, much of this road work has passed into the hands of the provincial supervisors, who, it is hoped, when conditions become more settled will take up energetically the very necessary work of maintenance.

HAULING A FIELD PIECE ACROSS A TEMPORARY BRIDGE IN THE ADVANCE ON MALOLOS.

The construction and maintenance of good roads, especially of trunk lines, has a very important military as well as commercial value and ensures peaceful conditions in a way accomplished by no other means involving the expenditure of the same amount of money.

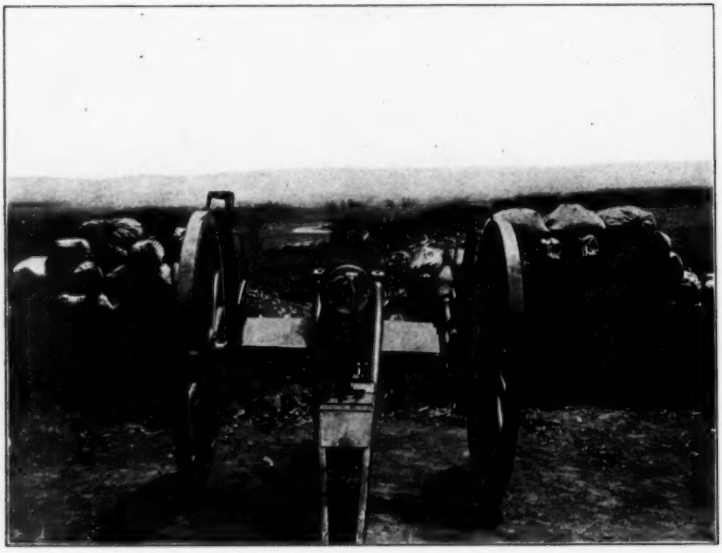
For the purpose of housing troops in permanent garrisons, sites for the new military stations have been surveyed and mapped, arrangement of buildings designed and water and sewerage systems investigated and planned. A careful examination of the islands of the archipelago for coal has been made. A wharf has been built at Zamboanga, and others are being built by the engineers at several different ports. Plans and estimates for the deepening of several river mouths have been

BRIDGE NEAR CALOOCAN; THE ARCH, DESTROYED BY DYNAMITE BY THE INSURGENTS, IS BEING REPAIRED BY THE ENGINEERS.

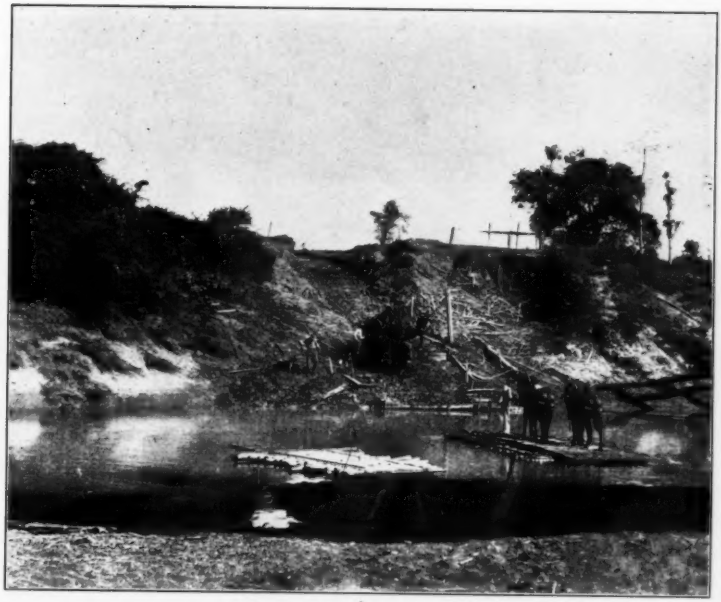


RAISING A LOCOMOTIVE WRECKED BY THE INSURGENTS NEAR ANGELES.

GUARDING THE WOUNDED, WHILE BEING BROUGHT IN DURING RECAPTURE OF THE WATERWORKS.

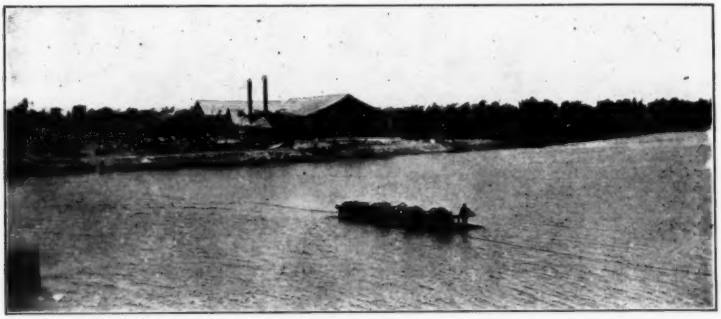


GUNPIT AND 3-INCH GUN OVERLOOKING MARIQUINA VALLEY, PROTECTED BY SAND-BAGS MADE OF NATIVE GRASS.



HASTILY BUILT BAMBOO RAFT.

BRIDGE STRIPPED OF FLOORING BY RETREATING INSURGENTS; FORD PREPARED BY ENGINEERS.



BAMBOO FERRY ON THE RIO GRANDE DE PAMPANGA, BUILT BY THE ENGINEERS.

made, and the port of Manila is now being extensively improved under the supervision of army engineers.

The civil engineering work in the city of Manila, a city of over 300,000 people, has been largely designed and executed under army engineers, including the building of new public markets of steel, a new steel bridge over the Pasig River, a public crematory, and model tenements.

The work of the engineers in the Philippines is just commencing, and many excellent opportunities are already beginning to show themselves. Railroads and street tramways must be built, coal and other minerals mined; Manila must have a new water supply and a sewerage system; other towns must have the same, and the construction of roads and bridges must be continued.

As soon as the future control of the islands becomes more settled, and the permanency and wisdom of the present government is sufficiently assured to warrant investment of capital and the extensive introduction of modern machinery to develop the industrial and mineral resources of the islands, an attractive and profitable field will be opened for members of the engineering profession.

A REMODELED PIECE-WORK SYSTEM.

By John H. Van Yorx, Jr.

Mr. Van Yorx will impress the practical shop manager by his eminent practicality. He frankly recognizes that there is no panacea for labor troubles—that some of the fundamental difficulties will remain as long as human nature is what it is, and that the best that can be done is to be just and to reduce the inevitable friction to the minimum possible. It is hardly necessary to add that the system described is in actual use.—THE EDITORS.

AS the demands of prosperity increase, the demands for a greater output and a cheaper product also increase. Not only technical magazines but even ones outside of technical lines are today dealing with this subject in innumerable lights, in their attempts to solve the many phases of the trouble between capital and labor. They are largely attempts to satisfy fully both capital and labor. The attempts have failed and will fail until human nature changes.

If it were possible for men, whether of capital or labor, to become satisfied and contented the next thing human nature absolutely dictates is to rest, with the result that the world stands still. There I would say the attempt to establish a system in a manufacturing concern which will satisfy both employer and employee is an attempt along false lines. What then is there to be done? At the present day this and this only: to establish a system which moves with the least possible friction to gain its end (that is all that can be done with the best piece of machinery ever built), and which at the same time does justice to both employer and employee.

One of the great troubles today lies in each realizing that the other wants as much of the benefits of the increase of production as he can get, and so suspicions and distrust are aroused. The system of which a general outline is here given is not a cure for all ills—not a thing to

stop all "kicking"—but a help and a help only for existing conditions, one that will make the workman feel and understand that the company is willing to pay him for his efforts. Nor is originality claimed for it, as it is the result of conclusions drawn partly from the study of different plans, and partially from knowledge and experience gained by personal contact with the system as used in a certain well-known machine-tool company. It is another form of applying well-known things, and there are undoubtedly many shops with as good a system perhaps as here shown, if not indeed a better one. On the other hand, there may prove to be something which will be suggestive.

Upon first appearance this system may seem to be complicated and unwieldy; but it deals with detail; detail is necessarily voluminous, but detail is the thing an up-to-date shop must have at the present time. Red tape is a thing necessary in carrying detail, but red tape should be reduced to the smallest amount possible. This seems to be largely lost sight of in many systems with their multiplicity of forms and unnecessary amount of clerical work to carry this detail, both in and out of the office. One of the advantages to be derived from this system is that it uses condensed forms and does not turn the mechanics and foreman into clerks. Immense loss is caused by systems requiring the foremen to spend hours writing that which should be done by clerks, instead of attending to the direction of their rooms. It is not an uncommon sight in some factories to see a number of men standing about from five to fifteen minutes awaiting a job or some direction in their work, either of which should have been ready for them when it was needed, while the foreman was writing a requisition for a piece-work contract, or entering the general information as to what a piece of work is and to what it is to be charged, etc., for the benefit of the next department. Here again is additional loss caused by the rewriting of standard information every time a piece changes hands. One of the objects, therefore, to be gained by this system is to reduce the amount of clerical work which the mechanic is generally forced into, and to transfer it to the hands of clerks to be done in as concise and compact form as possible. As far then as this system is concerned, the foreman's writing will consist of the information needed for temporary use, namely, the man's name, the date, and the time of starting. If the number of machines that the workman runs is liable to change, then the number of machines should be written.

A piece-work system is dependent upon other systems in the shop for its quietest running, as a machine is dependent upon its several parts.

In what follows price will be spoken of for convenience of expression although standard time is favored instead of price.

Before placing or changing a system in a shop, it should be carefully prepared and as nearly perfected as is possible for an untried thing. If this is not done and a system is put into operation in a partially prepared state, then in addition to the natural difficulies which are bound to arise, is added the confusion due to incompleteness and the accumulation of work awaiting the perfection of the system. This will cause dissatisfaction and delay which, if not remedied, will lead to defeat. The fighting should not begin until the decks have been cleared for action.

The first step is to give each machine that is manufactured a distinct symbol. What this symbol, which classifies the work, should be, depends upon existing conditions; it might be a letter or a figure, as best suited. This symbol when once fixed upon should follow each part wherever it goes in the shop; then whenever it is seen it will instantly be recognized as a part of some particular class of work.

The next step is to separate each machine into divisions, which will give the general location of the parts. The line should be sharply drawn between divisions, for if there is any uncertainty there will be confusion of records in the office and misunderstandings in the shop. Then each separate piece of each division should be numbered, starting at some well adapted part, such as the bed or base of the machine; the different parts should be numbered consecutively following a natural order through the machine, each washer, screw, etc., receiving its number. The number with the machine symbol once given should be the only thing by which the pieces are recognized. If names are used, confusion is bound to arise. After becoming accustomed to the numbers they are much more convenient and less confusing than names, as any foundryman will understand. One case to illustrate—a set of eight clutches, all of different sizes, operated by a pull pin; the tangles these records could get into in attempting to distinguish them by name were marvelous.

The pattern number and piece number should be the same, and they should be numbered in that manner in the drafting room, together with the symbol. The drafting room is the only place where that work can be properly done, as there is where the machines are designed or altered and there it is definitely know whether a piece or screw is to be used on more than one machine or in more than one place. Thus it is for them to start the system right by giving like pieces the same number, so that no possible confusion of prices can

Machine 30" Lathe Division Headstock Job No. 1200-1225-1250 Sheet No. 1.

Symbol K

REQUIRED			NUMBER		OPERATIONS												PIECE NUMBER	LOCATION OF PIECE
NO.	MAT.	SIZE	PATTERN	DRAWING														
1	MS	#6-#65		9846					A	S	M	F	P	CM	RT	T	80	Main Spindle

FORM 1. INDEX LEDGER SHEET. 12 BY 15 INCHES, ALLOWING A WIDE MARGIN FOR LAYING OPEN.

Red and blue rulings, heavy white paper. Under operations, the upper division is the operation symbol, the lower division shows the number of envelopes in file each with a different process of doing that operation.

arise. The confusion caused by placing prices upon pieces and carrying parallel records and trusting to chance for their proper adjustment is a fault of some systems.

With the information thus obtained, together with such information as cannot be carried conveniently in the file—such as number required, sizes, material, and any other information that may be found necessary—the books are made up. These books as shown in Form 1 are an index to the file. These books should be of the detachable-leaf variety and be so arranged that one would be able to gain all the information desired at a glance. That is to say, if the piece number, operation, division, symbol, size, material, etc., were wanted they might be had without looking in more than one place for them.

We are now ready to start a piece of work through its shop career, and for our illustration we will take the main spindle of a lathe. The person in charge of starting the work takes the routing tag, as shown in Form 2, and attaches it to the rough stock, which is ready for the

Job No. 1750 Piece No. 80 K
Division Headstock
Location Main Spindle
Material M.S Forging Size 4½ x 48½
Drawing No. 9846 Pat. No. 80 K No. Req. 25
Details of Oper.

Rough turn to 7/32
Finish turn - leave .008 to grind

OVER

Man's Name	Date	TIME STARTED	NO. MCH.	Operations	NO. FIN.	O.K.
John Brown	2/2/03	7 am	1	Forging	25	G.D.
James Pledger	2/9/03	2 P.m.	2	Rough turn	25	F.T.
Thomas Morton	2/23/03	8:30 am	2	Chucking	25	L.Q.
Geo Johnson	3/1/03	7 am	1	Finish turn	25	G.J.
				Milling		
				Grinding		
				Assembling		

OVER

FORM 2. ROUTING TAG. 3¼ BY 6 INCHES, STRONG HEAVY MATERIAL TO WITHSTAND SHOP WEAR.

One side carries information, the other gives the route and history of a piece from start to finish.

first operation of forging as shown by the route on the tag. This routing tag is the connecting link between the order and tracing department and the piece-work department, which carries all of the information necessary to take the work from department to department to completion. When the work is completed the consecutive history should be shown upon the tag, whether it has followed its route, where the pieces were short in number if any, and if inspection should have shown poor or careless workmanship, the tag should show the name of the workman who did that operation. This tag should never leave

Receipt for Balances on Contracts Due April 11 '03

Contract No.	Amt.	Contract No.	Amt.	Contract No.	Amt.
8542	13 75				

Date April 13 '03 Total Amt. $ 13.75

Received Payment Geo Johnson

OVER

Date 4/11/03 Name Geo. Johnson

Remarks Not here pay day, recd money 13th.

FORM 3. PIECE-WORK CONTRACT, 3 BY 5 INCHES.

Duplicates of different colors, one retained in the office the other goes to the man. The front is the contract, the back is for the time. For prices not standard same form of another color is used.

the work except to act as a requisition for piece-work contracts, to which use the foreman of the forging department puts it as soon as he knows which of his men will do the work. As long before the man actually begins the work as is practicable the foreman should place the

tag in a receptacle for that purpose to be taken to the clerk who makes out the contracts, by a messenger who makes half-hourly trips throughout the shop, taking and delivering messages as well as piece-work contracts. This can be easily done by the foreman as he prepares the job for the men, for he must refer to the tag for information. He will need only to write the man's name and the time of starting.

Upon the tag being placed in the hands of the clerk, the contract should be immediately made out in duplicate, preceding any other duty. This contract is shown in Form 3. The price is then put upon the job and one of the contracts is returned to the foreman at the earliest possible moment. The duplicate contract, which should be of a different color from that which goes to the man, is retained in the office. No contract should be placed in the hands of a workman without a price, unless by special arrangement.

The price should be set by a man who can get out into the shop and find the particular way that a piece is done and the conditions that enter into its production. The foremen should not be burdened with this, as they are in many cases, principally because they do not have the time to attend to it properly; they do not have the details of record at hand, nor would there be uniformity of prices as compared with other departments. The price setting should, however, always be done in co-operation with the foreman in charge, although the decision of the one setting the prices, and who is responsible, should be final. After careful consideration of a price it should be put on the work *to stay*, the understanding with the man being that the price will not be changed, no matter what he may make, except for certain conditions which should be definitely and strongly set forth, such as changes of operation, jigs, and fixtures, or changes of design; something will be said later regarding this. The great evil of piece work is the cutting of prices, and it is along this line that piece-work systems need remodeling; for upon this depends the real success of the systems—not in the process of their working, perhaps, but in the final results.

If the price and details of operation on the contract just placed in the hands of the foreman meets with his approval, the contract is given to the man, who keeps it in a receptacle for that purpose near his work —if possible, convenient for the time clerk, unless the man keeps his own time (which he should not be allowed to do). From this contract card the time is made out on a suitable ticket and sent to the office, also the time clerk makes entry of the time upon the back of the contract card. In the office the time is entered upon the back of the duplicate contract card which was retained at the time the original was issued.

When the job is "turned in" the original contract and the duplicate must balance, thus acting as a check for mistakes and otherwise.

When the workman has completed the contract it is OK'd by the foreman or inspector, preferably by both. It is then turned over to the office, the amount of the man's day pay, which he of course has been receiving during the progress of the work, is deducted and the balance

Name	Geo Johnson	Pec. No.	T 80 K		
Division	Headstock	Job No.	1250	Cont.No.	8542
Operation	Turning to finish after being roughed, cut in five bearings to grind, cute thread leave .008 to grind				
Day Rate	250	Pec. Rate	345	No. Mchs.	1 Mch. No. 207
No Pecs.	25	Price	$2.00	Total	$50.00
Com.	7 A.M. 3/17/03	Foreman's O.K.	F. J.		
Fin.	3 P.M.	Inspector's O.K.	R. J.		
Remarks	Stock in excellent condition				

| | | | | |

T 80 K

Job No.	Prc.	RATE Day	RATE Piece	WORKMAN	No. of Pieces	No. of Machs.	Prem.	Machine
1250	2 00	2 50	3 45	Geo Johnson	25	1	13 75	30" Lathe

Turning to finish after being roughed, cut in five bearings to grind, cut thread.

FORM 5. FILING ENVELOPE; 3⅛ BY 5½ INCHES, STRONG WHITE MATERIAL OF HARD SURFACE.

Front (upper figure) gives the consecutive history of the operation; the back (lower figure) gives the details.

made payable to him. When he receives this balance he gives his receipt, as shown in Form 4. This receipt is very important, as it settles all future question as to whether a contract has been paid for or not.

After the contract has completed its active usefulness it is returned to the clerk who issued it, to be placed in a filing envelope and filed in a suitable cabinet as a permanent record for future reference. Form 5 shows the filing envelope, upon the face of which is the information necessary for the clerk who makes out the contracts. The envelopes

are numbered with the operation symbol or abbreviation, the consecutive piece number, and the machine symbol, and filed according to the piece number. Each operation takes a separate envelope upon which entry is made when the contract is given out. This envelope will give the correct history of the operation on a piece, showing the changes or advances made, or its cost from time to time and the reasons therefor; the back of the envelope should show the details of operation. Here let it be emphasized that it is very essential for the details of each operation to appear upon the envelope, even if trivial, and they should appear also upon the contract which goes to the man. The files which are made up of these envelopes must be in a compact form, to be immediately at hand so the person in charge will not be obliged even to leave his seat to obtain the desired information, for this person will be one who will have to count his minutes. For each operation the process is carried through as was the forging, until the piece has been completed and in place on the machine. The illustrations here shown are for the turning operation.

Under this system two men and a messenger can take care of 25,000 contracts during a year, with all of their mass of detail. This does not of course include the time or shop order systems.

Neither this system nor any other can be a success unless there is co-operation on the part of each individual who comes in contact with it. If it overloads the foreman with work, the work will not be done; if it causes continued distrust or suspicion on the part of the men, then it will have the same effect as any system which holds out rosy inducements that never can be realized. A person intuitively recognizes justice; if he does not openly he will by his action and conduct, provided that he is one who will grant it in return. Are there not a few in your factory concerning whom you feel that if anything goes wrong with their work it is not because of carelessness nor neglect on their part? And in turn do they not take what is done on your part as done in good faith? Yet there is not necessarily satisfaction on either side, but there is a tacit recognition of justice on the part of both. On the other hand, are there not some whom you feel are holding back and are careless (in some cases deliberately so) and who regard what is offered them as only a means to grind them down or squeeze more work from them? Here there is mutual recognition of injustice. While it is true that this condition will exist as long as human nature remains as it is and cannot be done away with or remedied, yet it can be alleviated.

The average man who receives justice hesitates long before he makes unreasonable demands or trouble. The source of his work and

the cause of considerable of his conduct lies with his employer. Then it is for the employer to take the initiative in the extension of justice in his own shop. If he deals out what he honestly considers justice, without watching to see the effect of each spoonful administered and looking for some demonstration, he will not hastily throw up a system which deals justice because he does not see results after the first dose. It would not be inferred that any thing but justice had previously or would subsquently be intended, but each feels that the other has a reserve and he in turn must have one with which to meet it; the consequence is a deadlock or the administration of force on either side, or perhaps underhandedness on the part of the man. By underhandedness is meant that if a piece of work can be done in six hours and a man takes ten to do it, conducting his work so that his foreman will think he is working hard (and perhaps he is in his endeavor not to), doing so on the plea that he is doing it in his own defense, he is underhanded, although he does not intend his action to be so. Its offset is to force that man to do the work in less time when it is discovered that he is delaying the work—provided it ever is discovered. How much less time it should be done in is very difficult to determine under these conditions, as the man will not help. Then follows a continual antagonism between the man and his employer which leads to every sort of trouble. Because of that result it would never be discovered what a man could really do until the cause had been removed or relieved and his confidence established. This can be accomplished only by giving him a real article. If he is to help the business let the business help him, and help him first.

Now a word somewhat aside yet bearing upon the subject. One of the sources of mutual benefits is shop improvement. It is a sort of axiom that only foremen and heads of shop departments with drafting rooms make new jigs, fixtures, new operations, or other improvements. It is taken for granted that a workman, no matter what his capacity, will do the same old job in the same old way until instructed differently, even if he knows a better way. Under some foremen a suggestion would be considered impertinence, yet there are a great many dollars locked in the hearts and minds of the workman that should be open for the mutual benefit of employer and employee. How they are to be gotten at is a problem of the day. It certainly can not be done by offering a bait to catch them, as a fisherman would so many fish, to be taken from the hook and used for his own purposes. In this case the fish has something to say. It can be done only by an honest, business-like exchange of benefits, permanent benefits both to employer and employee. If men

have been suspicious with or without cause, it will be an uphill fight to establish confidence in its place. Infinite patience must be used and a rigid holding to a strict line of justice—liberal justice, if perhaps it might be so expressed. The confidence of the men must be had to make any system succeed, but success does not mean a policy that will cause no controversies or differences of opinion, for it is of course possible to have a system which runs smoothly but accomplishes very little. Instead of running smoothly in such a manner, this system properly carried out will give rise to numerous troublesome questions which might otherwise be buried, but ougth not to be. To illustrate: suppose a $2.50 man is given a price of $3.00, and understands that the company reserves the right to cut if he makes above a certain amount, definite or indefinite, say $3.00 per day. Then he will make $3.00, or less, and if an accident does not reveal that his job can be done in less time, he will deliberately continue in that rut for years, perhaps, while the company congratulates itself that it has a system which is running smoothly. Presume this same man to have the price of $3.00 for that same work, given as a fixed price (barring conditions mentioned); if his confidence is established, and he *can* do it in six hours, he will do so and reap the benefit. This man will do all in his power to reduce the time by making the minutes count, possibly suggesting a jig or fixture, or change in design of that piece to expedite his work. This policy will serve also to bring up and to answer questions which would otherwise be overlooked, as for example whether one machine is faster or slower than another, or whether the belt may need tightening, or the countershaft speeding up, etc. I have known men to turn shafting of small diameter with numerous shoulders and similar work, all day, at speeds varying from 100 to 150 feet and to do good work, when their neighbors did not have the nerve to handle this work and turn out a good job at 80 or 90 feet—the best they could do. If the man who could run at the higher speeds had been afraid that his price would be cut so that he could make only $3.00 per day, then instead of the company having the benefit of that speed and himself making between $7.00 and $8.00 per day, he also would have used a speed of 80 or 90 feet, both the company and himself losing. The man would have protected his price and his fellow workmen who could not work at the same speed.

There are honest differences between the quantity and quality of work which different men can turn out, and these differences must be recognized. If in the above mentioned case, of the man who made $7.00 per day (an extreme case, by the way,) the price had been cut so he could make $4.00 per day, which would be excellent pay, then

the next man to get the job would not be able to make his day's pay unless the price was changed for the slower man, which of course would never do. If the first man again got the job at the cut price he would not put forth the same effort on this or on other jobs for less money, when he felt that he must do more work for it. Added to this is his uncertainty of knowing how much lower the price is going. Just or unjust as this may be, the result will be the same—the curtailing of production, which is the thing to be avoided. Let us look at this same case in another light. If the company consider the work on this piece to be worth $3.00 to them, accepting ten hours as a reasonable length of time for the completion of each piece, then the cost to produce that piece would be $3.00 plus ten hours' hourly burden of say 25 cents per hour, making the cost of production $5.50. The company have what they consider a fair equivalent in the increase of production and the decrease in the cost of the production of that piece. If more than ten hours are taken the cost of producing that piece increases accordingly. On the other hand, if the man by his own effort or contrivance can do a good job in four hours (taking an extreme case) then the figures would stand as follows: price per piece, $3.00, plus four hours' hourly burden, making the total cost $4.00. The company gain the increase in production and $1.50. The man gains all that he has put out his effort for, a confidence in the company's willingness to pay for what they get, and $2.00 on each piece.

Can a company afford to increase their own costs and put a restraint upon their just output by jealously watching the amount of money paid into their workmen's hands, without considering what they have received in return? It would be a parallel case for a concern to buy pencils for the office a dozen each day at 50 cents rather than pay $30 at once and receive a hundred dozen with the discount. If the 50 cents is compared with the $30 without other consideration, then 50 cents is certainly less than $30 to pay for pencils. A ridiculous comparison, some one says; but that is the way piece work or other systems are often looked at. That is, it might be said to a workman: "You may have $3.00 each for these two pieces if you take two days to do them in, but if you do them in one day this company cannot afford to pay you $6.00 per day, so you will have to do them for $1.50 each." That is exactly the proposition made to a man when the unconditional right is reserved to cut the price which is given to him. Will that man be apt to do two per day unless forced to do so? Is it a business proposition? Where would be the object for a man to exert his wits and his muscles to their utmost when he knows that he will re-

ceive no more in the end than if he had taken the full amount of time allowed? He feels that he is making money without compensation for a stranger (for that is what his employer is as far as any sentiment is concerned, with some exceptions) and he will ask you "if that is not the fundamental principle of slavery?"

We have one case of a piece-work job being done for years under the old-style system, 108 hours being the lowest record and extending from this up to 120 hours. Upon agreement with this man that his price would not be cut, no matter what he made, the time was reduced to 78 hours on the next job.

By the foregoing I would not infer that the first estimate for a price must be the fixed rate. That would be risking too much to misjudgment and mistakes which the most expert estimator is liable to. A contract can be issued upon a card of a special color, say blue. Any contract issued with this color should be understood as not necessarily being a fixed price; then let the job be followed by a trustworthy and competent person (this does not mean that a person must stand over the workman with a watch in his hand) and the speeds, feeds, and methods observed. This can be done several times if absolutely necessary, but not unless it is absolutely necessary, as it is a delicate proceeding not to give offense, and the one doing it should be the person least objectionable to the man, preferably the foreman if his duties will permit. With all precautions some mistakes may be made, but they will more than be recompensed by the general result. When the price is once fixed it may go out on a card of another standard color, to be recognized as fixed. Prices should be graded from the lowest to the highest priced man who will have occasion to do the work.

Having spoken previously of the right which the company should reserve, to reduce the price for jigs, fixtures, etc., and also of the rights of the man to be allowed the benefit in his price of these same things of which he is the originator, it will require a little additional information regarding an important part of this system to do away with any ambiguity which may be apparent. The man should be guaranteed that any benefit from any improvement introduced by him on a certain piece of work will be his without a cut as long as he does the work. He also should be given that piece of work to do as far as practicable whenever it comes along; then that man should feel compensated for his efforts. When the same work is given to another the price should be adjusted to meet the changed conditions, as likewise when improvements are introduced by the shop management. Any suggestion a man has to make should go directly to the shop management and not through

intermediate hands. The management can so arrange that there will be no obstacle in the way of a man making suggestions. That would mean a flood of worthless ideas, if interest were taken, which would give rise to a number of troublesome problems requiring much tact and patience; but if properly managed, capable men should be made to take more interest in their work when they feel that the management will respect them for their brains as well as for the quantity and quality of the work turned out. There are, however, a number of workmen, harsh as it may sound, in whom no personal interest could ever be aroused by any means. Like the poor, they are always with us and they must be accepted as a social condition. If, however, only 10 per cent. of the workmen in a shop could be made to feel this personal interest in their work, it would be a great success. I have known three men of this sort to change the general character of a department of thirty men.

As obtaining the object desired would depend upon the confidence the men had in the system, by no act should they be made to think it a scheme or a bait. Sometimes a long period is necessary to establish confidence in the face of suspicion, as they will keep a watchful eye upon every detail of any attempt to place a system, especially if it offers unusual privileges. Any small thing, however unintentional it may be, which has a "trappy" shade to it will cause distrust. It is better to err on the side of generosity than to risk the creation of that feeling.

These ideas incorporated into a shop system will not set every man to working like a dray horse, nor will it make each workman hold exactly the same interest in the general success of the business as the proprietor; but the larger proportion of the men feel an interest in what yields them a personal compensation. The human factor will not admit of any other condition, and that human factor is what the present-day system must be built upon. The future may have something better in store, but the future will take care of itself.

STORAGE BATTERIES ON ELECTRIC RAILWAYS.

By Howard S. Knowlton.

THE growth of applied electricity has created many new industries in the last generation, which have given employment to thousands of workers. Some of these fields of opportunity are cultivated on the ruins of occupations now discarded by the civilized world; others flourish by entirely new applications of human skill and intelligence, called into being by discoveries which have no counterpart in the past. Thus the manufacture of electric motors has turned horse-car driving into a lost art, while the production of storage batteries displaces no handicraft, trade or profession from its position in the structure of modern industrial life.

Storage batteries are utilized in almost countless ways by the progressive engineer of today. Their value in telephone and telegraph practice, railway and fire-alarm signalling, yacht lighting, surgery, dentistry, radiography, isolated plant, laboratory, central-station and electric-railway work, has been thoroughly demonstrated by long experience. While their usual function is to act as reservoirs of electrical energy which can be drawn upon for the supply of current in time of need, they have many other uses which render them valuable to the operator of electrical apparatus. Especially is this true in the case of street and interurban railways.

The storage of working power or energy is everywhere evident to the observer of natural laws and processes. He sees it in the rain cloud, whose tiny drops fall to the earth and strike their infinitesimal share of the mighty blow with which millions of drops overturn a house or bridge in a flood. He notes it in the lump of coal, charged with the solar energy of ages, in the ponderous drifting iceberg, in the coiled watch spring, the raised hammer, and the revolving engine fly-

wheel. It is almost impossible to name any operation of physical laws which is not based upon the storage of energy.

Electric railways are noted for the enormous momentary demands for power which their generating stations sustain. Generally the ratio of this instantaneous power output to the average load or power demand is much greater on a small system than in the case of a large one. The causes of these fluctuations are found in the constant starting and stopping of cars, changes in speeds, grades, curves, conditions of track and roadbed, and to some extent, the varying numbers of passengers carried. Far less power is required to run a heavy car at a speed of thirty or forty miles per hour on the level than to accelerate it to such a speed in starting from a standstill. A twenty-ton car making forty miles per hour may require sixty horse power or about forty-five kilowatts at the trolley wire, whereas in getting up to speed after a stop or slow down it may easily take two hundred and fifty horse power or one hundred and eighty-six kilowatts from the wire. Each car on a street railway may easily draw from three to six times its normal average current from the power station when accelerating, but fortunately on systems of large or even very moderate size, all the cars do not accelerate at the same time. However, the fluctuations in the demands for power are severe on all but the largest roads, with present types of railway motors and methods of controlling speed. The electric railway thus offers an attractive field for energy storage, in order to avoid the installation of current-generating machinery and transmission apparatus whose supplying capacity is greatly in excess of the average demands of the cars. Here the storage battery rises to the occasion, and, when financial conditions are favorable, it absorbs and gives out energy with signal success, in the operation of the system.

The popular impression is to the effect that such a battery stores up electricity, and that the bottled-up fluid is held somehow under pressure, to be released on demand like highly charged mineral water. The principle of the storage battery is quite different from this, as the entire action is chemical, fundamentally.

The storage battery is a simple piece of apparatus, mechanically. In its most familiar form it consists of two lead plates supporting active materials, a high oxide of lead for the positive plate, and metallic lead in a spongy, finely divided state for the negative. The plates are immersed in dilute sulphuric acid and contained in a glass jar or wooden tank lined with lead. Two plates, one positive and the other negative, constitute a couple, and a cell may be made up of as

many couples connected in parallel as the requirements of discharge necessitate. That is, all the positive plates are connected together separately from the negative plates, which are themselves joined in one aggregation independent of the positives. A battery consists of a considerable number of cells connected usually in series—that is, the positive group of couples in each cell is joined to the negative group of the preceding cell, so that the electric current passes through all the cells, seriatim. Since each cell gives a voltage or electric pressure averaging about 2.08 volts during its discharge, in railway work, we require two hundred eighty-eight cells in a battery which is to operate on a 600-volt trolley system.

Now, "charging" a storage battery simply means passing a continuous electric current through it from some outside source of supply, as a railway or lighting gentrator, and thereby causing certain chemical actions to take place. The energy of the current is thus stored up as chemical changes and recombinations, or in other words it is transformed into potential chemical energy.

"Discharging" a battery is naturally the reverse of the process just indicated. The battery is connected to a railway, lighting, or general power circuit, and it at once begins to deliver current, generated by the reversed chemical actions which begin to take place as soon as opportunity is given for a current to flow. Back goes the battery towards its original uncharged condition, and the cycle may be repeated over and over again, always with the same resulting chemical actions caused by, and then causing, the electric current. At each discharge there is an exceedingly slight deterioration of the active material on the positive plates, so that in a few years, more or less, these plates must be renewed, and are said to be "worn out." It is unnecessary to charge or discharge a battery entirely before reversing the process, and it may be drawn upon for electrical energy within the limits of its capacity just as freely as one would draw water from a reservoir. The voltage of a fully charged cell is about 2.6 volts maximum, and this is allowed to drop to about 1.8 volts per cell in discharge. The voltage of a battery thus is indicative of its condition with reference to being charged, as is the specific gravity of the acid and water, or so-called electrolyte, which varies from about 1175 at discharged to 1210 at the charged state.

Primarily, then, the storage battery applied to electric railway systems holds its position through its ability to absorb the violent fluctuations in current demand which would otherwise be thrown upon the generating apparatus and transmission system. Through

its power to charge or discharge at any point within its working range, the battery absorbs energy at times when the demand for it is light, and gives it out when the severe momentary pulls of the cars would impose a tremendous burden upon the power stations, sub-stations and distributing circuits. It acts like an elastic spring in taking up the shocks which arise from the sudden calls for power.

The use of batteries mounted directly on electric cars is practised but little in the United States. The great weight of the lead constructed cells militates severely against successful competition with the overhead-trolley system, the underground trolley, or the third rail. Batteries are, of course, in successful operation in automobile and light vehicle work, with some application to factory yard locomotives, but their present growing adoption by electric railways is almost without exception in the form of "station" or "line" service.

A storage battery in a railway power station relieves the generators and engines of violent fluctuations in load, and by charging at periods of light demand, it gives the generating machinery in many instances a steady load to work upon. This means better economy in operation and a reduction in fuel and water expenses which often more than pays interest and depreciation charges on the battery. It is well-known that electrical and steam machinery offers comparatively poor economy when underworked, and the battery goes a long way toward eliminating this troublesome feature. A great advantage of the battery is its ability to supply power during the night, or at times of sudden breakdown of the generators, engines, of boilers. This was well illustrated in a recent experience of the International Traction Company of Buffalo, which was heavily crippled for power when lightning burned out some of the transformer apparatus of the Niagara Falls Power Company, and shut down the industrial plants and railway systems for miles around. By the use of its storage batteries, the railway company was able to operate many more cars than its steam stations could handle.

Such a battery requires no attendance at night, and when charged, is available for power twenty-four hours per day, in conjunction with the regular generating machinery. Having no moving parts, it can be left by itself many hours at a time, with no fear of anything going wrong. Its value as a reserve in case of emergency is thus very great, on roads where the traffic is considerable. Its first cost, on the basis of its highest discharge rate, is about the same as that of an equal capacity of steam and electrical generating machinery. Batteries are often called the "watch dogs of the system" because of

the readiness with which they take up the work of current supply the moment the other machinery gives out or is overworked. The battery is always located in a room separate from other apparatus, as it is necessary to isolate the gases which rise from the cells, and which are harmful to copper, iron, and practically all commercial metals except lead. The cells are set up in rows mounted on insulators, which in turn usually rest on stout timbers. The connections are made by lead bars, or by copper bars covered with asphaltum or some acid-proof material.

When power is transmitted from the generating plant to sub-stations for local distribution, the battery occupies a similar useful position in connection with the sub-station machinery, with the added advantage of reducing the cost of transmission and transforming apparatus to the level of simply providing for the average power demand. Here, as in the main station, the battery takes up the load fluctuations, and gives the generating and transforming machinery a steady work to do. An example of a station battery may be quoted in the practice of the Seattle (Wash.) Electric Company, which has recently installed 278 cells of the "chloride accumulator" type in its Post Street plant. This battery is capable of discharging at the rate of 880 amperes for one hour at 575 volts, and thus has a maximum output of about 510 kilowatts, or 685 horse power. It weighs about 135 tons, exclusive of its supports.

The other great use for storage batteries in electric-railway work is on the line, at a considerable distance from power house or sub-station. Efficient service by the cars depends mainly upon their receiving current at the highest feasible pressure or voltage. The drop in line pressure as one recedes from the power house is often a very serious matter, and as the speed of the car motors at three hundred volts is about half the speed at six hundred, it is evidently of the highest importance to maintain as high a voltage as is possible all along the distant line, from the power station to the car farthest away from it.

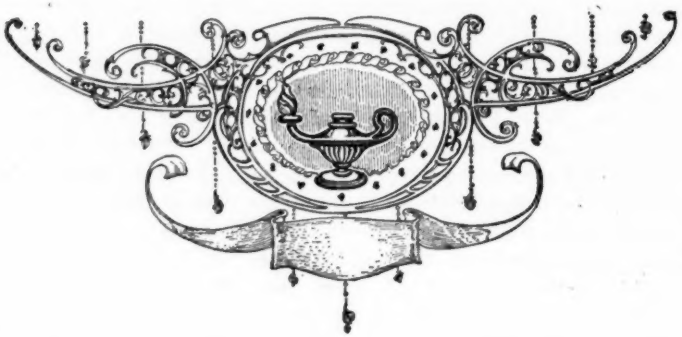
This can be done in several ways, the two most common being to put up heavier feed wire and thus add more copper conducting power to the system, or to install a storage battery out on the line, with the addition of little or no copper, and sometimes the removal of a portion of the wire already in service. The choice between the copper and the battery is always a problem in dollars and cents, as is the selection of a battery for station service, both demanding a skilled knowledge of electrical finance.

A line battery is usually installed in a car house or some inexpensive building devoted to its shelter, and it does its work with very little attention. If it is connected directly across the line between trolley wire and track it is called a "floating" battery, and its operation is very simple. When the cars running on that section of the road take little power, the distant power station charges the battery, and then, when heavy drafts of power are made by the cars, the battery discharges, and by reason of its nearness to the cars, holds up the line pressure and relieves the power station from excessive fluctuations. Of course, a battery cannot itself generate any energy, but must receive all its working power from the power station itself. When such a battery is installed near a heavy grade its assistance to the cars is still more marked, and in some cases it would be impossible for the schedule to be maintained if no battery were in service, without a prohibitive money outlay for copper feeders. The same advantages as to reserve power, all-night current available, etc., apply as well to a line battery as to one set up in a power station. Sometimes it is necessary to charge such a battery through a "booster" located at the power house, instead of letting it "float" upon the line continuously. The "booster" is a small generator driven by an electric motor or steam engine, and its function is to apply a higher voltage to the battery than could be obtained by simple feeders connected with the power-house machinery. Thus, the voltage of the generators in the station may be 600, but the line drop calls for a "boost" in this electric pressure of say 250 volts, in charging the battery. Boosters are also generally used to regulate automatically the charge and discharge of station batteries in connection with the generating machinery. An interesting example of a line battery is found at Long Beach, Maine, on the road from Kittery to York Beach. Here the Portsmouth, Kittery, and York Street Railway Company have installed a battery of 220 cells, capable of discharging 160 amperes current for one hour at about 460 volts. It is of course capable of discharging at a slower rate for a longer time. The main power house of the company is located at Kittery Point, some ten to twelve miles away, and the battery is thus of great use in helping to carry the heavy summer traffic which this famous scenic route creates. The battery is tucked away out of sight in the basement of a car barn, and the only sign of its presence on the outside is a tell-tale feed wire which runs into the building.

Another interesting recent application of the storage battery to street and interurban-railway practice is found in one of the newly developed train-control systems now on the market. The operation

of switches throughout a car or train for the control of motor speeds is set in motion by small electrically opened valves supplied with current from a 14-volt battery. This is naturally a small affair compared with the types which we have just been considering, and has but a limited use so far. Mention might also be made of the use of batteries in train lighting, but as this applies almost entirely to steam railroads, it falls without the scope of this article.

The future of the railway storage battery is difficult to predict, at present. If the progress of science develops a form of battery which is far lighter, and somewhat more efficient than modern types, there is no doubt that a revolution will be worked in methods of applying electricity to railway service. It would be a wonderful step forward to sweep away with one brilliant stroke of invention or discovery all the present complicated and expensive transmitting wires, transforming and distributing devices, which render an electric-railway system a labyrinth of intricacy at best. The marvellous triumphs in the study and manufacture of high powered explosives lead us to hope that some day electrical energy may be sold freely in concentrated battery cartridges, and applied to the propulsion of trains with an efficiency hitherto undreamed. Certain it is that the present applications of batteries to electric railway work will find a constantly increasing field of usefulness, as long as continuous-current motors are employed in driving cars, and with many able inventive minds bent upon the battery problem, there is at least ground for hope that a brilliant future may sometime be realized in the scientific storage of electrical energy.



LIQUID FUEL FOR POWER PURPOSES.

By Arthur L. Williston.

Professor Williston's opening paragraphs summarize briefly his preceding article, and the paper following completes the treatment of the question of the use of oil fuel from the economic side. With his study of the mechanical elements of the problem in our May issue, this forms a comprehensive and most valuable discussion of a new departure in power-plant engineering, in which there have been heretofore available only scanty and somewhat vague data. The importance of the subject lies in the possibilities of mechanical and industrial expansion which are opened by the successful burning of liquid fuel under the steam boiler. —THE EDITORS.

IN the preceding issue of the Magazine data were given regarding the heating values and boiler efficiencies that had been obtained by experiment with different fuel oils and steam coals; and we discussed the direct influence of liquid fuel upon the charges for fuel, firing, and repairs, and the conditions under which its use will result in reducing the annual operating expenses of the plant. But the influence of its use on the design and first cost of the power plant was left for the present article. It was shown that one pound of oil was equivalent to from 1.5 to 3 pounds of coal, according to the quality of the latter, and that a slightly higher efficiency—perhaps from 4 to 6 per cent.—might usually be expected from the oil; while the boiler capacity, or evaporation per square foot of heating surface, with it, might be increased from 30 to 50 per cent., without lowering the efficiency. The saving in the cost of firing, it appeared, would vary from little or nothing in very small plants to perhaps 75 per cent. in the largest, being equivalent to a reduction of 20 cents per ton of coal burned to produce an equal horse power, in the example which was chosen for illustration. The corresponding saving in cost in absence of ashes to be removed is 18 cents; but to offset these figures partly, it was found, were the two items of the cost of the steam for the burners —about 14 cents on the average—and 5 cents for additional repairs needed to keep the boiler settings tight and free from cracks when oil is burned. All of these figures have been reduced for comparison to a common basis by dividing the total amounts by the numbers of tons of coal burned when coal is used as the fuel.

Now let us consider the second phase of our subject—the indirect influence of the use of liquid fuel through alterations in the power-plant design causing a reduction in its initial cost, and a corresponding reduction in the annual fixed charges. This, of course, will apply only to those plants where it may fairly be assumed that a sufficient supply of fuel oil will be available, at a price which will make its use profitable, for a sufficient length of time to warrant our designing the plant to give the maximum economy when burning oil, rather than governing the design by those conditions which experience has proven to be the best practice when coal is used as the fuel. Oil burning for power purposes, on a large scale, is too new, and the experience is too short, for any large amount of accurate data to have been accumulated, consequently in discussing this part of the subject, I cannot make exact estimates. Nevertheless, experience has already definitely shown certain things that materially alter the design of the boiler plant where the permanent use of liquid fuel is contemplated. Two of the most important of these influences for us to consider here are:

First.—The increased rate of combustion with liquid fuel, which means an increased capacity for a boiler of given size, with greater, or with substantially the same, efficiency. As a result of this, it will be possible to obtain a given output with a plant of smaller size and first cost than would be considered good practice with coal under natural draught. The conditions will approach more nearly the practice with coal burned under a forced draught. This advantage of liquid fuel is particularly great where the steam consumption is liable to sudden fluctuations for comparatively short periods.

Second.—As has already been shown, oil may be burned with materially less draught pressure than is required for coal. This may affect the design of the boiler plant in two ways—it may mean that a smaller and less expensive chimney will be required, or it may mean that a considerable amount of additional heat can be advantageously abstracted from the flue gases by means of economizers, lowering their temperature to one materially below that necessary to maintain the proper draught pressure if coal were used. This will, of course, give a corresponding increase in both the capacity and the efficiency to the boiler plant.

The effect of these two influences upon first cost and annual charges can be judged from the following illustrations:

Suppose a boiler plant to furnish power for a lighting station which will require, during the period of heavy loads, 2,400 boiler horse power, but which, during the greater part of the twenty-four

hours, would require considerably less than 2,000 horse power. If this load fluctuates rapidly and, at times, is likely to exceed the 2,400-horse-power limit, it would be unwise to have, for regular service when burning coal, less than twelve 200-horse-power boilers. On the other hand, if the plant were designed entirely with reference to burning oil, the possibility of forcing the fires would make it safe to rely on perhaps but nine boilers of the same size. The same percentage of reduction in the capacity of any reserve boilers to be used in case of breakdowns or repairs could also be made. This reduction will affect not only the boilers but also nearly all the boiler accessories and the cost of the boiler house as well. We could. therefore, in this case, figure on a reduction in the initial cost of the plant of 25 per cent., with a corresponding reduction in insurance, taxes, depreciation, and repairs. Estimating the cost of such a steam plant at $32 per boiler horse power, the total saving would be $16,000.

It is fair to assume the following as an average for the fixed charges of a good steam boiler plant:

Interest	5	per	cent.
Taxes and insurance	1½	"	"
Depreciation and repairs	4	"	"
Total	10½	"	"

This would give a reduction in the annual fixed charges equal to 10½ per cent. of $16,000, which would be an annual saving of $1,680. In order that we may judge the effect that this will have on the comparative cost of coal and oil, we shall assume that our boiler plant, if it uses coal, will in the course of a year use 14,000 tons; the saving in the annual fixed charges would then amount to 12 cents per ton. There are at the present time, perhaps, comparatively few boiler plants where it would be wise to count on having a permanent supply of cheap fuel oil, but if the plant in the above illustration were not new but were contemplating an increase in its capacity which would be rendered unnecessary by the introduction of oil-burning appliances and the use of liquid fuel, it would be proper to credit to the oil the same saving.

The reduction in the draught pressure which is required for oil might affect the steam plant which we are considering in three different ways: first, if we keep the same draught pressure which would be necessary if coal were the fuel used, the design of the boilers may be so modified as to give a very much larger number of flues of smaller cross sections; or in case of water-tube boilers, a larger number of

tubes in the same area; thus, in both cases, increasing the heating surface, efficiency, and capacity of the boiler; or second, if the design of the boiler is kept in accordance with present practice, it will be possible to reduce the height of the chimney 30 per cent. to 40 per cent., reducing its cost in a still greater ratio; this, however, in most cases would not reduce the total annual expense by more than 1 per cent. or 2 per cent.; or, third, as I have already suggested, the decreased draught pressure required with oil makes it possible by means of economizers placed between the boilers and the up-take, to lower the temperature of the escaping gases, to a point far below the temperature that would be required to maintain the draught needed in order to burn coal. In this way, both the efficiency and the capacity of the plant may be increased, and experience has shown that a saving of from 10 to 15 per cent. may usually be expected. The chief objection to the economizers, too—the difficulty of keeping them clean and free from soot and ashes—is removed in the present instance with the liquid fuel.

These amounts—12 cents for reduced fixed charges and perhaps from 25 to 35 cents for the saving due to economizers—should be included in the calculations of the relative cost of coal and oil for fuel in the cases to which they properly apply. They would not materially alter the final result in such extreme cases as the examples chosen for illustration in the previous article, where it was found that for New York city the use of oil will increase the cost of fuel 69 per cent., and for California, New Orleans, and Texas, that it might reduce it by an equal amount. In other cases, however, where the comparative cost of the two fuels is nearly the same, it is important that these items be carefully considered when plans are being prepared for power plants of magnitude. In certain cases where there would be no direct saving in the cost of fuel from the use of oil, there might, it is apparent, nevertheless be because of its influence on the design of the plant, a real saving amounting to as much as 40 or 50 cents per ton in the price of coal. There are certain other cases, too, in which there might be no real saving—perhaps even an increase—in expense, and yet where it would still sometimes pay to use liquid fuel. I refer to locomotives, especially for passenger and heavy or fast freight service, and to the merchant marine and the naval service. The space will permit me to refer only most briefly to a few of the reasons in each case which might make the use of oil advisable aside from any relative saving that might be derived from its use as compared with coal. The locomotive has already nearly reached the limit of its possible capacity because of its limited boiler

capacity, yet the demand for greater boiler power for both fast passenger trains and heavy freight service still continues to increase. The help that oil can give to the solution of this problem by increasing the boiler capacities gives it a value entirely apart from its value in a stationary plant. Other reasons are its ability to respond quickly to sudden loads; ease and time saved in starting and in extinguishing fires; freedom from sparks, cinders, smoke and ashes; and ease and time saved in loading. The increasing demand for prompt certain, and cleanly service on our railroads make these advantages of fuel oil have great weight. For the merchant marine service all of these conditions which favor the use of oil on the locomotive equally apply, with the additional advantage of the economy of fuel storage space, allowing more room for paying cargo. For naval use, the military advantages may be even more important than the commercial advantages which are as great here as they are in the merchant marine. Freedom from smoke, and the extension of the steaming radius by permitting more fuel to be stored in the same space, are incalculable advantages; while a fuel that will increase the efficiency and the capacity of the boilers, or increase the speed with which full power may be obtained on short notice, increases the value of the whole battle-ship in almost as great a ratio.

The whole question of the economy of oil burning, however, ultimately turns upon the price of oil at the wells, and the available annual supply. Figure II shows the average yearly price of the Pennsylvania oil per barrel at the wells over a period of years from 1860 to 1901. It has fluctuated from a minimum price of 10 cents in December 1861 to a maximum price of $12.00 in July 1864; but as a rule the price has been fairly constant, decreasing on the whole as the production in the United States has increased. In a general way, the price of Pennsylvania oil controls the price of nearly all the other crude oils, and they fluctuate as it fluctuates, the relative price always remaining practically constant and depending on the relative values for refining. At the present time, with Pennsylvania oil selling in the neighborhood of $1.50 per barrel at the wells, Ohio and Indiana oils are worth only about $1.00 and 95 cents respectively. This is because of the sulphur in the latter oils, which makes the process of refining difficult, and also because of the smaller percentage of the light oils valuable for illuminating which they contain. The quality of the California crude oil varies very greatly according to the location of the wells, some of it being excellent for refining purposes and some of it being almost worthless and suitable only for fuel. The range of prices at the wells,

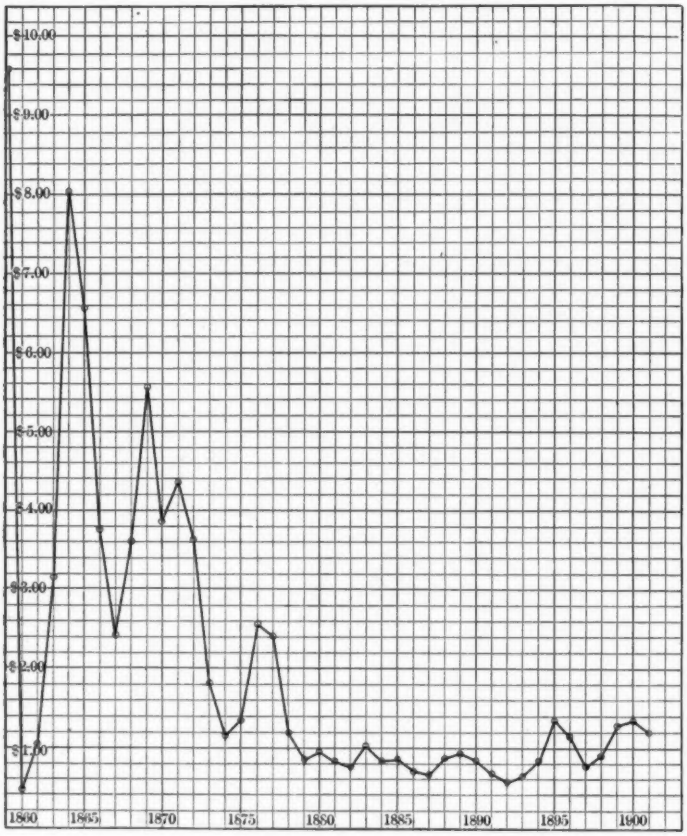


FIG. II. CHART SHOWING THE AVERAGE YEARLY PRICES OF PENNSYLVANIA CRUDE PETROLEUM AT THE WELLS FROM 1860 TO 1901.

therefore, is correspondingly great, varying from 20 or 25 cents per barrel to about $1.00, with a present average value of 55 cents at the wells. The value of Texas oil for refining is very little indeed, in fact, almost nothing. It contains little or no naphtha, which is the most valuable constituent in the Pennsylvania oil, and while it contains a reasonable percentage of kerosene, this is of somewhat uncertain character and produces an illuminating oil of an inferior grade. If its price were to depend on its refining value, it would be very low.

The supply of oil which is available for fuel, therefore, is, first, the small percentage (probably not over 2 per cent. or 3 per cent.) of the total production of the Pennsylvania and Ohio oil—the residuum from the process of refining; second, crude oil from the Ohio and Indiana fields, wherever the price of coal makes the burning of oil at 95 cents or $1.00 per barrel (plus freight) profitable; third, those portions of the California oil which are not best suitable for refining; fourth, practically the entire output of the Texas field.

FIG. 111. CHART SHOWING TOTAL PRODUCTION OF PETROLEUM IN THE UNITED STATES FOR EACH YEAR FROM 1860 TO 1901.

The demand for the better grades of oil for refining purposes will, probably, keep pace with its production; consequently we can never expect to see such grades of oil compete with coal to any large extent. On the other hand, the refining value of the Texas oil and much of the California oil is so low that its value will probably always be largely controlled by the demand for it for fuel purposes. It is inconceivable that a fuel which has so many distinct advantages and which is not unlimited in its supply should sell at a price which would make it cheaper

to burn than coal in all markets. The great demand for it would bring its price up at once. On the other hand, the price of oil that has little value for refining will always remain low enough to enable it to compete advantageously with coal over a sufficiently wide area to create a demand for it that will equal its supply; and so long as there is an assured supply of Texas and California fuel oil in those regions where coal is especially scarce and poor in quality, it is improbable that its price will ever reach a point that will prevent its very extensive use for power.

At the present time the total production of petroleum in the United States is upwards of 70,000,000 barrels a year. Figure III shows how this production has increased year by year from 1859 to 1901, and

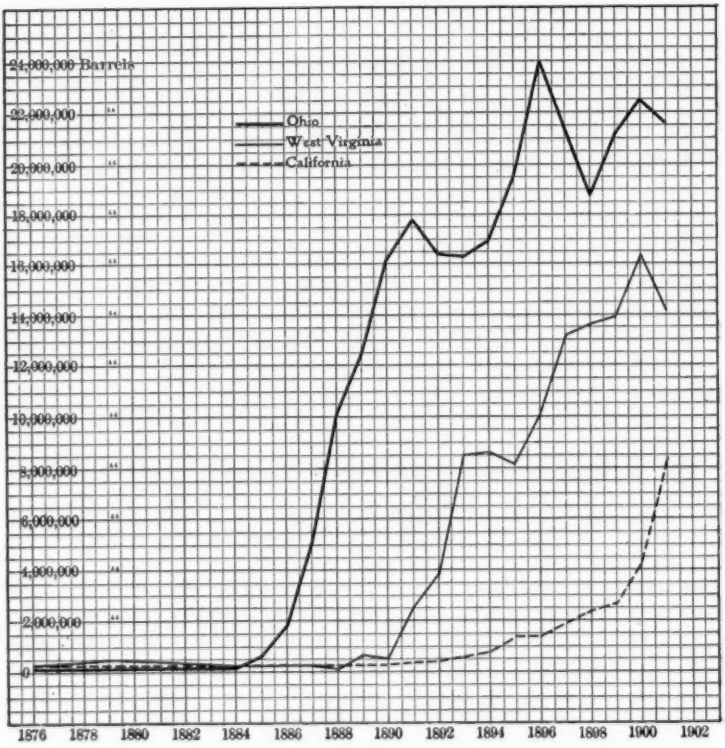


FIG. IV. CHART SHOWING THE ANNUAL PRODUCTION OF CRUDE PETROLEUM IN OHIO, WEST VIRGINIA, AND CALIFORNIA, FROM 1876 TO 1901.

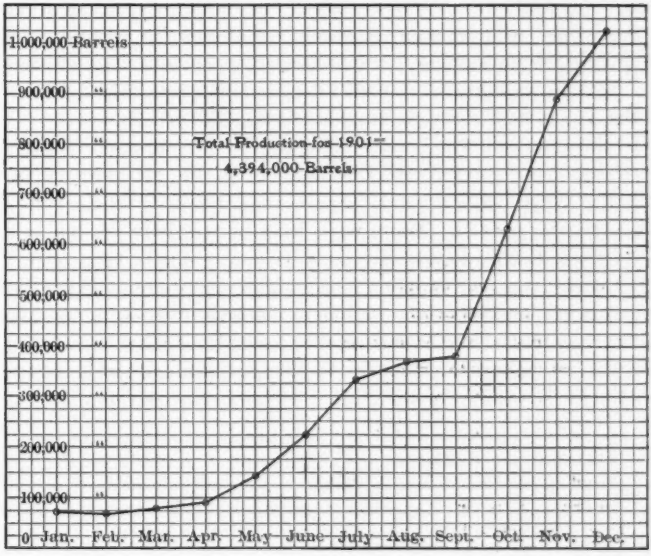


FIG. V. CHART SHOWING THE PRODUCTION OF TEXAS CRUDE PETROLEUM FOR EACH MONTH OF 1901.

(Barrels of 42 gallons.)

Table IV shows how the production of 1901 was distributed among the principal fields, and the average yearly price per barrel at the wells in each field.

TABLE IV.

Field.	Production in 1901, Barrels.	Average Price.
Pennsylvania oil, Appalachian field...	33,618,000	$1.21
Ohio (Lima) and Indiana.....	21,648,000	.86
		.83
California	8,786,000	.50
Texas	4,393,000	.28
Miscellaneous	944,000	
Total	69,389,000	

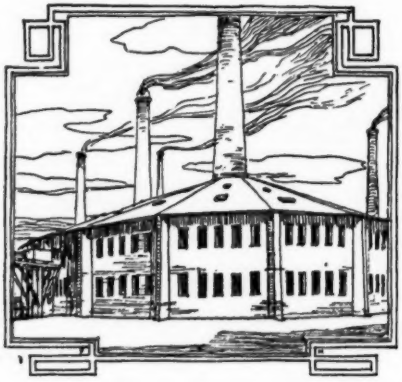
It will be noticed that in 1901 more than 80 per cent. of this total was produced in the older fields of Pennsylvania and Ohio. Texas produced in 1901 but 4,393,000 barrels, a trifle over 6 per cent. of the total output of the United States. Figure V shows how this 4,393,000 barrels was distributed over the months of the year. More than one-fourth of the total was produced in the last month. Accurate

figures for 1902 are not yet available, but if the production in Texas for December 1901 remained constant for the twelve months of 1902 —allowing for no increase—it would correspond to a yearly output of over 14,000,000 barrels. Unofficial estimates place this total output for the Texas field for 1902 at over 20,000,000 barrels.

In this connection it is interesting to note the curves in Figure IV which show the growth and development of the oil industry in the Ohio, the West Virginia, and the California fields, from the time that they were first opened. Many wells have been exhausted, but in each one of these fields enough new ones have continually been opened to more than keep up the supply. It is possible that Texas will not follow their example, and it is always a dangerous hazard to make prophecy—especially in regard to oil wells—yet in the light of what knowledge we have, the following statement by Mr. F. H. Oliphant in the report of the Mineral Resources of the United States seems conservative:

> "In all reasonable probability there are other localities (in the Texas field) that are capable of producing wells of large production. It is probable that this section bordering on the Gulf will have its periods of depression following its present prosperity, which in time will be followed by the legitimate business of the production of petroleum. The final result seems to be assured that Texas will, in the course of time, be at the head of the list of the oil-producing States in this country."

If this last statement proves to be true—as the Texas field is the only oil field near the American seaboard—it means much for the future development of the use of liquid fuel for power purposes.



EDITORIAL COMMENT

THE controversy of eye-bar *versus* wire-cable construction for the Manhattan Bridge across the East River has fought its way through the correspondence and the editorial columns of many classes and grades of publications, and the drawn battle transferred to the aldermanic chamber rests its first stage with a temporary setback to the eye-bar project. The trouble about the whole affair is that the fight is being carried on in the wrong field, at the wrong time, and by the wrong contestants. No discourtesy is meant to the able and earnest engineers who have gone into the calculations, nor to the excellent journals which have published their discussions. But these very publications have emphasized the evident fact that the question is wholly one of economy, which can be determined only by the figures prepared, and offered as *bona fide* bids, by the leading competitors for the respective types of construction.

Taking into account the effect of pre-eminent facilities, there is practically only one concern that knows exactly how cheaply a wire-cable bridge can be built. There is practically only one other concern that knows exactly how cheaply an eye-bar-cable bridge can be built. The manifest advantage to the city is to leave the alternative open until the competition of the two plans has placed this knowledge at the public disposal. It is not likely to be attained if the city deliberately excludes either plan from the preliminary negotiations. The presumption may be against the economy of nickel-steel eye bars, but either scheme is good engineering. Either will make a good bridge. The retention of both under consideration until the costs have been figured by those who alone can figure them accurately, is good sense.

* * *

THE expression "His death is a great loss" has become so trite that it slips easily off the tongue and makes very little impression upon the imagination; but when used of the late George S. Morison in connection with the Isthmian Canal it seems to be suddenly invested with new and impressive meaning. Of all the members of the Commission, his study of the Panama route had been most closely specialized, most sustained, and most enthusiastic. He took a profound and beyond question a most thoroughly unselfish interest in the spreading of a clear understanding of the advantages of that route, and the reasons making its adoption and completion the only rational policy for the United States. Probably his last public communication on the subject was the article which appeared in our June number. Living, he would have made an energetic and invaluable member of the construction commission, to which we hoped he might have been appointed. But his work lives, and much of it was so far finished that the canal, when completed, will really be in considerable part a monument to his genius.

* * *

THERE is, we believe, a very important industrial sequence suggested in the remark with which we preface Mr. Kershaw's leader in this issue—that

trade-unionism in America is rapidly growing up to a strength relatively as great as it has already attained in Great Britain, and is patterning after the same policy. It means, if we are to believe the many able commentators who have discussed the reasons for the lately celebrated American ascendancy, that one of the important elements in that ascendancy will rapidly lose much of its impelling force. It is decidedly questionable, for example, if Mr. Orcutt were to rewrite the article on the "Development of Trade Under Competitive Conditions," which appeared as the fifth section of his study of "Machine-Shop Management in Europe and America" in our issue for May, 1899—it is decidedly questionable whether he could now be so confident that "the general spirit among American mechanics is to get the most out of a machine or tool, and to improve it if possible." It is very possible that he might now find, in many skilled trades in the United States, some of that same "tendency to make the job hold out" which he then remarked as the distinguishing characteristic of the European mechanic. And it is possible, further, that he might now wish to modify the characterization of the European worker as "indifferent, non-ambitious . . . a massive, inert stumbling block to progress"—at least, to the extent of excepting the new leaven of a very different temper which has appeared abroad since he wrote. And when we pass from the rank and file of the workers to the leaders, it is hardly open to question that British organized labor is led by men of higher type and wider vision than any but a very small minority of our American labor leaders. In fact, the careful study of the reports of the Mosely Industrial Commission from Great Britain, which recently visited the United States, would suggest that the disparity in the circumstances and capacities of the working classes, as between Britain and the States, is not so great as is commonly assumed, and that part at least of the difference of which so much has been made is due to what is frequently referred to in the Mosely reports—the recent "Expansive nature of American industry," due to the peculiar conditions of a new and rapidly filling country.

It will be most interesting to see these impressions tested by the renewal of a keen competitive struggle in foreign markets, when any slackening in home-trade activity again sends the American manufacturer abroad. He will find his foreign rivals far better equipped than in 1897—largely with weapons he himself has supplied. Has he made equal gains in industrial position during the same epoch?

* * *

SELDOM, perhaps never before, has the distinction between the solid work of the engineer and the cloud castles of the promoter been so clearly marked out as in the phenomena presented by the present industrial and financial situation. The paper millions of Wall Street are blowing away into the thin air out of which they were called into brief and ghostly appearance by the lately great "leaders of finance"—and the real sub-structure of sound business and productive energy underlying is not even shaken by the financial storm. The industries of the country go on with scarcely a perceptible pause or slackening, while the "industrials" of Wall Street collapse upon their inflators. It is a striking demonstration of the distinction insisted on by Mr. George H. Hull, writing in these pages in August, 1900—the distinction between a financial panic and an industrial depression. And it is a suggestion that the retreat of the "Napoleons of Finance" has already begun.

REVIEW OF THE ENGINEERING PRESS.
"THE WORLD IS ITS FIELD"

ENGINEERING CONFERENCES.

PRESIDENTIAL ADDRESS AT THE OPENING OF THE THIRD ENGINEERING CONFERENCE AT LONDON.

J. C. Hawkshaw—Institution of Civil Engineers.

AT the third Engineering Conference of the Institution of Civil Engineers an excellent amount of good work was done, and the benefit which such gatherings have upon the development of the profession is becoming distinctly apparent. We are reviewing elsewhere some of the special papers and discussions, but the opening address of Mr. J. C. Hawkshaw, the President of the Institution, itself furnishes an excellent statement of the nature and objects of the conference.

After referring briefly to the work of the two preceding conferences, Mr. Hawkshaw proceeded to touch upon the important engineering works which have been accomplished since the conference at the Glasgow Exhibition, two years ago.

"Some great works have been completed in the last two years; to name two only, both connected with the distribution of water: the Nile dams for irrigation purposes, and the Coolgardie water-supply; for the latter water is pumped up 1,200 feet and conveyed 300 miles inland in steel pipes.

"The last 2 years have been marked by the work done by the Engineering Standards Committee, work of which it is impossible to overrate the importance to the trade of this country.

"This Committee, which began its work in April, 1901, is the outcome of a Committee appointed by the Institution of Civil Engineers at the suggestion of Sir J. Wolfe Barry. It has been supported actively and financially by the five leading Technical Societies and by the Government, who, on the recommendation of the Board of Trade, have made a grant of £3,000 towards the necessary expenses. Sir F. Hopwood, in conveying to the Standards Committee the decision come to by the Treasury, said that the Board of Trade regarded the work undertaken by the Committee of the highest value to the country at large.

"Some idea of the magnitude of the work undertaken may be gained from the following figures:—there are 23 committees and sub-committees, made up of 296 members, of whom 24 are Government representatives.

"So far only one Committee, that on Building and General Bridge Construction, and one Sub-Committee, that on Tramway rails, have issued the result of their desion, but the conclusions of all are now in an advanced stage."

The subject of engineering education in connection with practical training came in for a due share of attention, and the widening scope of the work of the engineer received emphasis. The demand for specialists, so far from limiting the necessary information required for the practical engineer, has rather extended it.

"What branch is more specialized than that of the electrical engineer, and yet he has to deal with the same problems as the railway engineer in questions of transport and locomotion, as the gas engineer in questions of lighting, with the chemical engineer in questions of the application of electricity to industries, and so on. The engineer who would reach the highest po-

sition in his profession should have a knowledge of organization, of administration and of finance, besides the necessary knowledge of the branch to which he specially devotes himself."

That this relation of the engineer to general affairs is being more fully realized is seen in the extent to which members of the engineering profession have entered into public affairs with conspicuous success, and there is every reason to believe that in the future the profession of engineering will prove as direct an entrance into public life as that of the law has been in the past.

Many important problems are now presenting themselves before the engineer and demanding solution. Mr. Hawkshaw refers more specifically to those which appear in London, but these have their counterparts in many other large towns. Thus: "We have dealt with the sewage question, and remove some million of tons of sewage daily by water underground, but we have yet to grapple with the removal of the solid matter, with which we daily pollute, not only the atmosphere of London, but that of the country for many miles round. Many of the fine old trees for which the neighborhood of London was noted, have gone, and moreover, an ever-widening area must follow. The destruction of the fine collection at Kew is only a question of time. Sir W. Thistleton Dyer, after a week's fog, found a deposit of tarry matter on the greenhouses at Kew at the rate of six tons to the square mile. Dr. W. N. Shaw, at the Sanitary Congress at Manchester, estimated, roughly he admits, that it takes seven million tons of air a day to carry away the smoke compared with one million tons of water a day required to carry away the sewage. A bad fog may cost £5,000 a day for light alone, and the estimate made of the cost of smoke pollution to London, which puts it at as much as five millions a year, is probably below the mark.

"Another question which becomes yearly more pressing in London is that of the means of locomotion and transport. Like smoke pollution, our neglect to deal with it is yearly costing the growing population of London a large sum. The King, recognizing the importance of this question, has been pleased to appoint a Royal Commission 'to report as to the measures they deem most effectual for the improvement of the same, by the development and interconnection of railways and tramways, on or below the surface, by increasing facilities for other forms of mechanical locomotion, by better provision for the organization and regulation of vehicular and pedestrian traffit or otherwise; and further to report as to the desirability of establishing some central authority or tribunal to which all schemes of railway or tramway construction of a local character should be referred, and the powers which it would be desirable to confer on such a body.'

"The terms of reference are very wide, and it will tax the powers of even so able a body as the Royal Commission which has been appointed, to find a satisfactory solution. The more facilities you give for traveling and locomotion, the more persons you encourage to travel and take advantage of the better means of transport and locomotion, so that the application of the remedy tends in some measure to spread the disease. Decentralization is what is wanted, and if facilities for transport and locomotion encourage this, it will be a distinct gain to London, especially if it affects factories and workshops, the greatest offenders, with slow and obstructive traffic and smoke pollution."

An important element in connection with the problem of transport is found in the growth of the use of automobile vehicles on highways. At the present time the use of such vehicles is principally governed by considerations of sport and recreation, but with improvements in construction and reductions in cost, the automobile must be reckoned with as an element in the question of the transportation of both persons and merchandise over extended distances.

"We have had experience of how the advent of railways checked the progress of canals and also of motors, which were far advanced nearly a century ago. It is to be hoped that tramways will not again check the progress of motors, and their use, not only for private, but for public service. Tram lines render roads less suitable or serviceable for all other kinds of traffic. It is well worth considering whether it would not be advisable to make

roads suitable for motor traffic of all kinds, and let motors serve public as well as private purposes. Railways afford greater facilities than canals, but motors offer greater facilities than either railways or tramways, and though all three are necessary, nothing should be allowed to check the legitimate development of motor traffic."

The questions thus touched upon in the opening address are but a few of those which came up for discussion at the conference, but they serve to show the broadening in the scope of the work of the engineer and the extent to which that work is entering into matters both of daily life and of governmental administration. That this tendency is bound to increase is the firm conviction of all who have had occasion to examine the subject, a conviction which must be strengthened by an examination of the papers and discussions of the conference recently closed.

MODERN VIEWS OF MATTER.

REALIZATIONS OF THE DREAMS OF SCIENTISTS AS FORESHADOWED IN THE LIGHT OF MODERN RESEARCHES.

Sir William Crookes—The Congress of Chemists.

AMONG the important and interesting papers presented at the recent Congress of Chemists, at Berlin, may be mentioned that of Sir William Crookes upon the latest views as to the constitution of matter.

As long as a century ago, the British, generally regarded as a most material and practical people, endeavored to investigate the ultra-mundane particles of matter. In 1809, Sir Humphry Davy, in a lecture at the Royal Institution, maintained that there must be some substance which forms the common basis of all metals. Foreshadowing the modern conception of the electron, he used the expression, "radiant matter," thus showing that he had grasped the ideas which to-day are assumed to express the latest notions of the constitution of matter. Faraday, the illustrious successor of Davy, in various places in his famous "researches," shows that he, too, had grasped the same idea. While the so-called chemical "elements," about seventy in number, are assumed, in accordance with a convenient working hypothesis, to represent the ultimate constituents of all substances, yet it is well understood that these are not the absolute limit of the knowledge of the chemist, the physicist, or the philosopher. There are secrets beyond, and every thoughtful man will do his utmost to penetrate beyond the present temporary barriers.

Sir William Crookes quotes the prophetic words of Sir Humphry Davy:

"If the particles of gases were to move in free space with an almost infinitely great velocity—*i. e.*, to become radiant matter—they might produce the different species of rays, so distinguished by their peculiar effects." At the time these words were uttered, they were passed over almost without notice, but at the present time their profound significance may well be appreciated. In like manner we may recall the experiments of Faraday upon the magnetization of light, and his explanation of magnetic power lines. It is true that in Faraday's day it was sought to explain the phenomena observed by him upon the basis of physical action of the magnetic lines of force, not upon the light itself, but upon the refracting medium through which it passed; but in view of recent researches, it is evident that he saw much further than those who sought to explain the results by more obvious methods.

Thus matters remained until 1879, when Sir William Crookes himself, at the Sheffield meeting of the British Association for the Advancement of Science, brought up again the idea of radiant matter, stating: "Whether the gas originally under experiment be hydrogen, carbon dioxide, or atmospheric air, the phenomena of phosphorescence, shadows, magnetic deflection, etc., are identical."

From that date down to the present the progress has continually been more rapid, and the theoretical work of Faraday, Weber, Lorentz, Gauss, Zöllner, Hertz, Helmholtz, and others has led to the practical work of Becquerel, the Curies, and others, and the marvellous experience with

radium, and the phenomena of radiography. The electron theory offers an explanation of the constitution of matter which, in the light of recent experiences, at least, must be considered as acceptable, furnishing, as it does, a clue to the elementary substances of which the coarser chemical elements are composed.

In closing his eloquent address, Sir William Crookes, who, by his own work and researches has contributed as much, if not more, than any other one individual to the development of modern views as to the constitution of matter, said:

"Thus we stand at the frontier where matter and power pass into one another. In this field lie the greatest scientific problems of the future. Here lie the ultimate realities which are as far-reaching as they are wonderful. But it must never be forgotten that theories are only useful as long as they admit of the harmonious correlations of facts into a reasonable system. Directly a fact refuses to be pigeon-holed, and will not be explained on theoretic grounds, the theory must go, or it must be revised to admit the new fact. The nineteenth century saw the birth of new views of atoms, electricity, and ether. Our views to-day of the constitution of matter may appear satisfactory to us, but how will it be at the close of the twentieth century? Are we not incessantly learning the lesson that our researches have only a provisional value? A hundred years hence shall we acquiesce in the resolution of the material universe into a swarm of rushing electrons? This fatal quality of atomic dissociation appears to be universal, and operates whenever we brush a piece of glass with silk; it works in the sunshine and raindrops, and in the lightnings and flame; it prevails in the waterfall and the stormy sea. And, although the whole range of human experience is all too short to afford a parallax whereby the date of the extinction of matter can be calculated, protyle, the 'formless mist,' once again may reign supreme, and the hour hand of eternity will have completed one revolution."

THE MODERN EQUIPMENT OF DOCKS.

ELECTRIC DRIVING OF CRANES, HOISTS, WINCHES, AND OTHER MACHINERY AS COMPARED WITH HYDRAULIC POWER.

Walter Pitt—Institution of Civil Engineers.

ELECTRIC driving of general machinery is now generally regarded as wholly in accordance with the best modern practice, but there are certain special departments of work in which older methods are still regarded with favor. Among these latter may be considered the use of hydraulic power for the operation of dock and harbor machinery, and hence the paper presented by Mr. Walter Pitt at the recent engineering conference of the Institution of Civil Engineers is to be regarded with interest. Mr. Pitt boldly takes the bull by the horns and advocates the substitution of electric for hydraulic power transmission.

The late Lord Armstrong is quoted as saying that he felt satisfied that in point of safety, controllability, and adaptability for various purposes, electricity had little chance of ever rising to the level of hydraulic power. That, however, was more than fifteen years ago, and with all deference to the great authority of any utterance of Lord Armstrong upon an engineering question, there is good reason for believing him at least to be somewhat prejudiced in favor of a system which he himself had done so much to develop.

Mr. Pitt is certainly fully aware of the success which has attended the application of hydraulic power to the equipment of docks.

It was the requirements of docks that first caused attention to be paid to the production of a practicable method of distributing power over a large area, and resulted in the evolution of the hydraulic system of power-distribution, a system which has for many years been worked out with such thoroughness, and which has done such excellent work, that a modern hydraulic dock plant had come to be considered as almost beyond criticism, and yet at the present moment we may say that he would be a more than conservative engin-

eer who would seriously recommend the adoption of a complete hydraulic equipment in a new scheme of any magnitude.

In dockyards we find in every direction, and separated often by considerable distances, appliances that require power to drive them. In the warehouses there are cranes, travelers and lifts; on the quays there are jib-cranes, capstans and coal-tips; and about the entrances and locks there are sluice-lifting gear and gate-winches; in addition, there are generally workshops, sometimes on a very complete scale; and last, but not least, the whole place has to be lighted at night. All these duties have to be performed in the first place effectively, and in the second place economically. The first thing is always to do the work well, rapidly, continuously, with the minimum of stoppages and breakdowns, and also with the minimum of skilled attention: the second consideration is to do all this at the minimum of cost, giving due weight to first cost, upkeep and working expenses.

Viewed from the standpoint of the man who has to use the machinery, and not also to provide it and pay for it, no fault can be found with the operation of the hydraulic appliances to be found in well-equipped docks of the present day. The question is not as to defects in the hydraulic machinery, but rather as to the greater advantages and superior economies of electric driving, for this as for other power applications. The measure of the value of machinery at docks and harbors, in other words, is not greatly different from that obtaining in the machine shop. No establishment can long continue to use advantageously machinery which its competitors have cast aside, scrapped, and replaced with later devices. If the dock and wharf machinery of the leading Continental ports is examined, it will be found almost entirely arranged for electric driving. At Hamburg, Bremen, Rotterdam, Naples, Genoa, etc., the change from hydraulic to electrical appliances along the docks is becoming almost universal. The same is true at important river ports, and a general inspection only is needed to show that in England alone has this transformation been lacking.

There are good reasons for these radical changes. At the time when hydraulic machinery was first introduced there was no other method of power transmission so well adapted for the special work in hand. To-day the electric transmission can do everything accomplished by the hydraulic machinery, and very much more besides, and do it at a cheaper rate. The same central power plant can be both for power and for lighting. This gives a combination of day and night load enabling the most efficient power plant to be installed and operated, and both the mechanical and the electrical engineers have promptly grasped this great advantage.

In order to permit a concrete comparison to be made, Mr. Pitt considers the crane as one of the most important of dockyard appliances. Here there is not much difference between the initial costs of electric and hydraulic crane installation, so far as the machines themselves are concerned. The electric crane is slightly more expensive than the hydraulic, and the electric generating plant is probably somewhat cheaper than the hydraulic power-generating machinery. When we come to consider the connecting link between the power-house and the cranes, however, we find an immense advantage on the side of the electric leads as compared with the cost of the hydraulic mains. As to operative efficiency, the electric crane undoubtedly far exceeds the hydraulic, the quantity of cargo loaded or unloaded per horse power being much greater for the electric than for the hydraulic machine. These facts are fully verified by comparative tests which have been made both at various Continental ports, and also at Glasgow, the working conditions being as nearly similar as actual practice would permit. From data of these tests, given somewhat in detail in Mr. Pitt's paper, it appears that the hydraulic-crane power-consumption varied approximately between one and three times that of the electric crane per cycle of operations. The actual money cost naturally varies in different localities, but it may fairly be considered as mainly proportional to the power consumption.

At the same time, there are other very important considerations to be taken into account. The extreme flexibility of the electric system, the ease with which modi-

fications and extensions may be carried out, and the general convenience may often be of greater money value than the entire cost of the motive power. Machines may in all cases be placed exactly where they are most needed and where they can be operated to the best advantage, and the getting of the power to the machine in the electric system is a matter which need scarcely be considered.

In this respect, Mr. Pitt's paper is somewhat deficient, since it treats mainly of the relative power costs of the two modes of power transmission, and mentions only incidentally what in machine-shop practice has been found to be the greatest advantage of electric driving, the superior convenience and economy in the application of the power.

So far as the actual, practical side of the question is concerned, there really seems to be little room for difference of opinion. The size and importance of the vessels sailing from Continental ports leaves no uncertainty as to the severity of the tests necessarily undergone by any appliances there practically installed. It must, therefore, be only a question of time before methods which have been demonstrated to be successful at such ports as Hamburg or Bremen are adopted at other places where the competition with the great express steamships and heavy freighters of the Continental lines is already being felt.

THE ACTION OF STEAM JETS.

THEORETICAL AND PRACTICAL CONSIDERATIONS IN CONNECTION WITH TURBINES AND OTHER STEAM JET APPARATUS.

Institution of Engineers and Shipbuilders in Scotland.

ALTHOUGH steam jets have been used in connection with injectors, blowers, and similar apparatus for many years, and more recently in some forms of steam turbines, the principles upon which they act are not always fully understood. In the paper recently presented before the Institution of Engineers and Shipbuilders in Scotland by Professor W. H. Watkinson certain phenomena relating to the action of steam jets are discussed in a lucid and interesting manner, and in view of the extent to which jets are employed in various machines, some abstract of this paper will be found acceptable.

It is well known that when steam is obliged to pass through a contracted orifice, what is termed "wire drawing" takes place. In the ordinary reciprocating engine wiredrawing is produced when the ports and passages are too small; when the valve opens slowly; or when the piston speed is very high. The result is a drop in pressure in the cylinder, as compared with the pressure in the steam chest, an effect generally assumed to be injurious. More important are the problems in connection with steam turbines, wire-drawing calorimeters, steam-jet blowers, steam-jet pumps, and also those arising in connection with the possibility of superheating steam by wiredrawing.

The definition of wiredrawing, as given by Professor Watkinson, is that when steam flows from a vessel through an orifice or nozzle into a space where the pressure is lower, without doing work on anything but itself, the steam is said to be wiredrawn. Under these conditions it is sometimes said that the steam has expanded without doing work, but this is a loose form of statement, leading to incorrect conclusions. As a matter of fact, steam never expands without doing work. If it has nothing else to work upon, it will do work on itself, giving itself kinetic energy, and the work which it does on itself is exactly equal to the work which it could have done on a piston under the same difference of pressure and under similar conditions.

The work which is done by expanding steam may be represented graphically in various ways. The most usual form of diagram is the pressure-volume diagram, ordinates representing pressures, and abscissas showing the volumes, the area of the diagram corresponding to the amount of work done. If it is desired to show the work in terms of heat units, the temperature-entropy diagram may be used, in

which the ordinates represent temperature and the abscissas entropy, the area being in heat units. In either case the area is a graphical representation of the work done, and in either case the amount of condensation during expansion is shown. Professor Watkinson compares the action of steam upon the piston of a reciprocating engine with that of a jet upon a De Laval turbine, and shows that, all other things being equal, the work absorbed in imparting kinetic energy is the same as the work delivered to the piston.

The form of the nozzle used for a steam jet is an important element in its performance. Experiments with straight or contracting nozzles have demonstrated that the pressure is considerably above atmospheric, and hence the jets increase in diameter on leaving the nozzle. This action shows that some portion of the pressure energy is, in such cases, expended in giving other than axial motion to the steam. The natural result of this diversion of energy is that the axial velocity of the steam is less than it would have been if the whole of the pressure energy had been expended in giving axial motion to the steam. A knowledge of these facts has led to attempts to improve the efficiency of the jet by a modification in the form of the nozzle. As long ago as 1869 Schau discovered that a diverging nozzle was of marked advantage in connection with injectors, and the adoption of this type of nozzle in connection with steam turbines by De Laval enabled him greatly to increase the efficiency of his turbines.

The experiments of Mr. R. D. Napier fully demonstrate that the pressure in an orifice through which steam is flowing is never less than the pressure which, with given initial and final pressures, will give the maximum mass rate of discharge. For steam the pressure in the orifice for the maximum mass rate of discharge is approximately 0.58 of the initial absolute pressure. This holds good provided the pressure in the space into which the steam is flowing is not greater than 0.58 of the initial absolute pressure.

In examining the action of a steam jet the temperature-entropy diagram possesses certain advantages over the pressure-volume diagram, as Professor Watkinson shows. Thus, the pressure-volume diagram shows only the work performed by the steam, while the temperature-entropy diagram, besides showing the total work, also gives the state of the steam at any point of the expansion, and can be made to show the condition of the steam after the kinetic energy has been converted into heat. The manner of applying the diagrams for the solution of the problems connected with the steam turbine is discussed in Professor Watkinson's paper, and also their use in connection with the superheating of steam by wiredrawing. For these details the reader must be referred to the original paper, in which examples are worked out.

A comparison of the theoretical treatment, with the actual results, shows where the defects exist, and where efforts for improvement should be directed. Thus, in an ideally perfect wheel, the steam leaving the wheel would, relatively to the wheel, be flowing parallel to the initial jet, and the velocity of the wheel buckets would be half the velocity of the steam jet. In actual turbines the velocity of the buckets is much less than this, and the two streams are not parallel. For these reasons the steam has a high residual velocity when leaving the wheel, and the residual kinetic energy is, by friction and eddies, converted into heat.

Some of the later attempts to increase the efficiency of steam turbines of the bucket type involve the multiple-action effect, a number of wheels being fixed on the same shaft, and the steam passing from one to the next, and thus utilizing a greater proportion of the kinetic energy of the steam. Such turbines permit lower rotative speeds than those consisting of but a single wheel, while maintaining a high efficiency, and constructive difficulties are thus minimized.

The possibilities of such steam turbines are well shown by the fact that Professor Rateau has constructed direct-connected turbo-ventilators, giving a pressure of half an atmosphere, and turbo-pumps with lifts of several hundred metres. Such installations include plants of several thousand horse power, compressing air to more than 6 atmospheres, and raising water to more than 600 metres, or over 2,000 feet!

INTERNAL-COMBUSTION ENGINES FOR DRIVING DYNAMOS.

THE DEVELOPMENT OF THE LARGE GAS ENGINE AS AN ECONOMICAL AND RELIABLE MOTOR FOR ELECTRIC GENERATORS.

H. A. Humphrey—Institution of Civil Engineers.

AT the recent conference of the Institution of Civil Engineers, a paper which elicited an effective and interesting discussion was that by Mr. Herbert A. Humphrey upon the availability of the internal-combustion engine, and especially of the gas engine for the purpose of driving electric generators. This question is all the more important in view of the increased attention which is being given to the general electric driving of machinery of all sorts, since many of the objections to the gas engine, considered as a direct source of power, disappear when electricity is used as a means of power transmission and application.

"The central-station engineer is now fully alive to the fact that the gas-producer and gas engine constitute the cheapest means of generating electric power where coal is the basis of the energy. The internal-combustion engine is rapidly attaining to sizes of units which are large enough to suit even the big tramway-stations, and, when suitably designed, has proved quite as reliable for driving alternators in parallel as the best steam-engine.

"Single-cylinder single-acting gas-engines, although made in large powers (600 H. P. to 700 H. P.) by the John Cockerill Co., of Seraing, and by Messrs. Richardsons, Westgarth & Co., in England, would not usually be chosen in large units for dynamo-driving, except where regularity is not important. It is interesting to note, however, that 100-H. P. gas engine sets of the single-cylinder single-acting type are actually in use at the Embrach Works, driving belt-driven three-phase alternators in parallel, a small additional fly-wheel being placed on the armature of each machine."

Concerning the various types of construction adopted by different makers, Mr. Humphrey refers first to the *vis-à-vis* engine, made both in England and in Germany, using either two or four cylinders, for powers from 500 to 1,200 horse power. Although this type has done excellent service, it is now being abandoned in favor of double-acting single and tandem-cylinder engines. Engines of the *vis-à-vis* type have been used for driving alternators in parallel on a large scale, showing the entire practicability of using the gas engines for such service.

After reviewing the extent to which engines of the twin-cylinder and double-tandem types have been made by Körting Bros., by the Premier Gas-Engine Company, by the Nürnberg and the Cockerill Companies, Mr. Humphrey proceeded to discuss the lines of improvement open for the gas engine.

"Many attempts have been made to get over the difficulty of a piston-rod stuffing-box, and Messrs. Dick, Kerr & Company years ago constructed and ran at Belfast engines with double-acting pistons and piston-rod glands. The solution of the problem has, however, come gradually, and the Cockerill Company, followed by numerous other makers, have now examples of efficient stuffing-boxes fitted in the closed ends of gas-engine cylinders and giving no trouble. Once this difficulty is removed, the gas-engine must logically be manufactured as a double-acting machine, for by simply duplicating the valve-gear twice the power and twice the number of impulses are obtained from the same size of cylinder without increasing any of the working-stresses. So completely has this fact been recognized that all the leading makers now construct double-acting engines; and powers of 1,000 H. P. with single-cylinder engines, and of 4,000 H. P. with double-tandem engines, of the double-acting type, are readily obtainable. Nearly all the important orders which are now being placed for large gas engines are for the double-acting type, and all the modifications give thoroughly efficient prime movers for central-station work. In fact, the tandem-cylinder engine and the vertical two-cylinder engine are among the chief favorites on the Continent and in England. The Nürnberg Company and the Deutz Com-

pany build double-acting tandem engines which leave very little to be desired in the way of simplicity, smooth running, and good turning-moment qualities.

"The Nürnberg engine has the whole of the weight of the piston and piston-rods carried on slides running on guides, so that the piston and stuffing-box friction is reduced to that due simply to the rubbing contact on the piston-rings and the packing in the glands. The front slide constitutes the ordinary crosshead, and the back slide-block is utilized to introduce and discharge the water required for cooling the pistons and piston-rod. This type of engine has so far reached the lowest consumption of both gas and oil for a given output of power."

The new type Westinghouse gas engine bears a close resemblance to a vertical steam engine, there being two double-acting Otto-cycle cylinders carried on A frames and coupled by connecting rods to overhanging cranks below. Among other large gas engines in use and under construction may be mentioned those of the Oechelhäuser type, built by the Deutsche Kraftgas Gesellschaft for the central power station at Ilsede Hütte. Here there are 6 units of 1,000 horse power each, coupled to alternators supplying three-phase current at 10,000 volts pressure to rolling mills at Peine, 5 miles distant, and replacing an equivalent power of steam engines.

The most extensive installations of large power gas engines for electric driving, however, have been made by Körting Bros., of Hannover, and in the tabulated list given by Mr. Humphrey this firm is credited with 37,000 horse power of engines in units of over 200 horse power driving electric generators, and more than 75,000 horse power in units greater than 200 horse power for all purposes. The list of gas engines of 200 horse power and over compiled by Mr. Humphrey gives some interesting information concerning the development and application of internal-combustion motors for electric driving, since it shows the number of engines delivered or in hand by various builders, both for electric driving and for other purposes. Thus, there appears a grand total of 328,065 horse power divided among 515 engines, or an average of 637 horse power per engine. Of this power 206,805 horse power, or nearly two-thirds, is applied to driving electric generators, so that it is evident that the large gas engine has well entered upon the field of electric power-generation.

Mr. Humphrey gives it as his opinion that sufficient attention has not been given to the construction of gas engines intended to take a supply of both gas and air, separately stored under pressure. For central stations of large size the previous compression of the gas and air, so that they may be drawn as required from reservoirs, has much to recommend it, and involves, with proper precautions, no special danger. The advantage of the two-cycle gas engine would then be attained, without the complication of each engine carrying its compressing-plant, together with all the extra valves and gear required. Also, there is no reason why the heavy and somewhat noisy cam-gear on gas engines should not be replaced, and the valves operated by compressed air, or even high-pressure burnt gases stored from the motor-cylinder itself, controlled by a small rotating valve.

The term "internal-combustion engines" embraces oil-engines, but oil-engines above 200 H. P. are rare, and cannot compete in cost of fuel with gas engines using cheap producer-gas, especially when the system of recovering the ammonia from the coal—as in the Mond producer plant—is available. The Diesel oil-engine has attained a high degree of economy, and has been applied to dynamo-driving up to 200-H. P. units.

In general, a gas engine, giving at least one impulse per revolution, is necessary for all central-station direct-coupled dynamo-sets; and in cases of alternators working in parallel, engines should be chosen which give two impulses per revolution. The exact solution of the alternator-in-parallel problem is too complicated, owing to the interaction of the sets, to be given here, but some idea of the relative value of different types of engines for this class of work can be gathered from the Klönne diagrams, which enable the curves for the turning moment, the angular velocity, and the angular deviation to be plotted and compared. By using these diagrams, Mr. Humphrey makes a comparison between the various types, showing the

vast advantage of the 4-cylinder, 4-stroke cycle and the 2-cylinder 2-stroke cycle engines over those having a fewer number of power impulses per revolution.

Mr. Humphrey made but a brief reference to the possibilities of the gas turbine, for the reason that experiments now being made upon motors of this type are as yet incomplete, and definite information is not available for publication. The subject of the gas turbine, however, is being pushed experimentally by several investigators, and there is every probability that operative machines may soon be made public.

In view of the mass of data and information contained in Mr. Humphrey's paper his emphatic conclusion appears to be fully justified, namely, that the large central electric stations of the future will employ producer-gas and gas engines, and that existing stations will have gas engines installed for additional power with the ultimate object of the entire replacement of all steam plant.

THE PRESENT INDUSTRIAL CONDITIONS IN SOUTH AFRICA.

A SUMMARY OF THE SITUATION IN THE ENGINEERING FIELD BY A CORRESPONDENT ON THE GROUND.

Mines and Minerals.

IT is a matter of general comment that the recovery of the mining industry on the Rand has been deplorably slow, and that the boom in South Africa, which was hoped for as an immediate result of the ending of the war, has lingered long on the way. Recent reports have been more cheerful, but not yet do they suggest that rush of activity which should follow the restoration of peace, according to all prediction and general precedent. It is interesting, therefore, to get a definite statement of conditions in a form to make comparison with normal standards, and such a statement is given in brief in a communication to *Mines and Minerals* from their correspondent, Mr. F. J. Frank.

"The best month in the history of the Rand was August, 1899, when 85 companies were operating 6,340 stamps, and produced 408,324 ounces, worth approximately $8,291,467. Since the war, owing to the difficulty of obtaining labor, these figures have not been approached, although rapid gains are being made. The returns for January of this year, show that 3,065 stamps were running and produced 198,163 ounces, which is about half what the output was before the war. . . . The lack of labor is, of course, greatly retarding the development work and in that way affects business in general. The number of 'boys' employed previous to the war was 96,704, and at the end of December last year there were but 45,968."

This situation, however, Mr. Frank expects to see relieved, "even if they are obliged to adopt the extreme measure of importing Chinese coolies," and he is evidently disposed to accept the view of a writer in the *African Review*, who predicts for the future "immense prosperity. No goods will be too luxurious to offer, and nothing too costly." The undertakings actually in sight on which this forecast is in part based are thus summed up:

"The amount of gold still in sight on the Rand is variously estimated at $3,000,000,000 to $15,000,000,000. It is thought that eventually 16,000 stamps will be running, but if this estimate be cut down to the conservative figure of 12,000, or 6,000 additional stamps to the present equipment, it means an outlay of over $30,000,000 on surface machinery alone, as it costs at the rate of $5,000 per stamp for the stamps and auxiliary machinery.

"The deep-level mines will need very large plants, no doubt larger than any existing plants, especially in hoisting machinery. The firm that can successfully design and build a hoist for these great depths can find plenty to do in this field.

"While the Rand is a tremendous field, it is by no means the only one in South Africa, and the other gold fields, diamond mines, and coal mines, which are fast being developed, offer a good opportunity for business.

"The railway field is a large one, for it is estimated that 4,000 or 5,000 miles of new railway lines will be built in the next ten

years; some of these lines are in course of construction. They will cost about $120,000,000. The existing railways are adding largely to their equipment to meet the demand of a very much increased business.

"It is planned to spend $30,000,000 on the harbors of South Africa in improvements, and the Government has a $150,000,000 irrigation scheme under consideration. All the agricultural districts are without tools or implements."

In this expansion, American manufacturers, Mr. Frank thinks, are going to play an important part, and he quotes from press reports an impressive list of machinery shipments already received or actually ordered from some of the best known makers of electrical, agricultural, or mining machinery in the States—houses already widely known as world traders. But to the less experienced American exporter, Mr. Frank repeats and urges the admonition, so often heard and apparently so little heeded, to give more attention to the details of his foreign shipping business.

"Notwithstanding the excellence in general of the articles offered there have been many bad blunders made, notably in the construction and in the packing; so that, while there is much reason for congratulation because of the showing made, still there is great room for improvement. Where successs has been obtained to any marked degree these faults in packing and construction have been overcome and a volume of business has resulted that has more than repaid any trouble taken or expense incurred.

"Since the war, competition has been very keen, there being more than twenty bids on a recent engine contract and other lines are almost as bad. . . . In the opinion of many, inferior packing and carelessness in omitting some of the necessary parts have caused more loss of trade than the competition. Whether this be true or not, certain it is that many rank errors occur which are certainly the fault of the manufacturers and cause them loss of trade. If shippers could but realize that goods sometimes lie for months exposed to the weather at the coast before they are forwarded up country, greater care in packing might be taken and many reputations saved.

"I saw a case of files that arrived after being eight months en route, and there was but little left but rust. Most explicit instructions had been given by the buyer and, as is so often the case, no attention was paid to his wishes and they were put up about as they would be for a pleasant summer day's journey from New York to Yonkers. It causes great annoyance to the buyer, who loses not only the goods, but also sees his trade go elsewhere because his stock is exhausted. A dealer at home has a wholesale house almost at his doors, but the dealer in South Africa is obliged to wait for months before he can obtain a new consignment, even though he uses the cable, which is an ideal profit destroyer.

"Another item of packing that is too frequently overlooked is that much larger boxes than necessary are used. Large spaces are filled with straw and the coat of vaseline and wrapping paper necessary to protect metal from rust in salt air is left out. Ocean freights are determined by measurement, and so the big-box habit is costly.

"The complaint is often heard that the Americans, in filling foreign orders, act on the principle that as the goods are going so far away, if they are not up to the standard the firms are never likely to hear of any trouble caused. Neither are they, nor likely either to hear of any more orders coming from that source. So many times machinery of inferior workmanship and design and faulty construction is sent when, needless to say, just the opposite course should be pursued if the manufacturers ever hope to build up a successful foreign business. The policy should be that nothing is too good for the foreigner, as he is so far from a base of supply that the goods should be as near perfection as it is possible to make them.

"Many times large orders of machinery are received, only to find that in packing some very essential small parts have been left out, and a delay of some months is caused and frequently a suspension of important work. Extra expense is incurred by cabling and at the risk of being misunderstood. If it is a dealer who has a contract with a time limit and a forfeit attached, it is not hard to imagine the state of his mind, nor his pocketbook, when he finally gets an acceptance. It would be a

small expense to the maker to have a thorough system of inspection of all foreign shipments. A few nuts and bolts of odd sizes that are missing make a great difference at the other end of the line where such things are not obtainable."

The trouble is that the American manufacturer too often resorts to foreign trade only in times of home depression, and neglects it as soon as things pick up again in his local field. As long as he plays fast and loose with the business in that way he must expect to be taken up in the same manner—only as a makeshift, when his foreign competitors with a more stable policy are overloaded with orders.

IRON AND COAL IN AMERICA AND GERMANY.

THE RAW MATERIALS USED IN THE PRODUCTION OF IRON AND THEIR TRANSPORTATION IN THE UNITED STATES AND GERMANY.

Herr Macco—Verein Deutscher Eisenhüttenleute.

THE great growth in the production of iron in the United States has attracted the attention of Europe more and more, and has led the technical men of Great Britain and the Continent to study the American iron industry, with the view of determining whether the American supremacy in this field is due to natural causes beyond human control or simply to improved methods of transportation and manufacture, and whether this supremacy is likely to be permanent or is only temporary.

Great Britain and Germany, America's great rivals in the iron industry, have given particular attention to these questions; they have sent individuals and commissions to the United States to carry on investigations, and have discussed the various aspects of the subject at the meetings of their engineering associations, as well as in the technical and even in the lay journals. While final conclusions have not yet been reached, much light has been thrown on the matter, and among the recent contributions to the discussion, a paper by Herr Macco, read before the latest convention of the Verein Deutscher Eisenhüttenleute and published in *Stahl und Eisen*, is of special interest on account of its comparison of American and German conditions.

Herr Macco takes up the various raw materials which enter into the manufacture of iron, and analyzes the figures for their production and cost of transportation. The greater part of his paper is devoted to the United States, and is based on the reports of the Geological Survey and other Government publications. It contains many tables and a mass of valuable information, only a small part of which can be touched upon here.

Considering coal in the first place, the figures for 1901 show that two-thirds of the bituminous coal mined in the United States comes from the Appalachian fields, and that one-sixth is from the "central" coal fields of Illinois and the neighboring States. Pennsylvania leads all the other States by far in the production of bituminous coal, and also produces practically all the anthracite.

During the last eleven years, the average productive capacity of the miners, per man and per day, has increased more than one-quarter, while in Germany it has, if anything, diminished. This favorable showing for America is ascribed to the largely increased use of machinery for coal cutting, 25.7 per cent. of the bituminous output for 1901 being machine mined. In spite of the higher wages paid in America, the prices for coal are much lower than in Germany, the average American price in some years being less than half the German.

In the production of coke Pennsylvania again leads all the States, her output being about two-thirds of the total, and a comparison of the American and German prices shows that the latter are from one and a half to two times as great.

Of late years, the most remarkable phenomenon in the production of iron ore in the United States has been the enormous development of the Lake Superior region, and, particularly, of the Mesaba range. In 1901, Minnesota, where the latter fields are situated, was the leading State in the production of iron ore, its output being 38.45 per cent. of the total, while Michigan was

a good second, with 33.4 per cent. As an indication of the magnitude of some of these Minnesota mines, it may be mentioned that the output of one of them, the Fayal, equals the combined product of all the mines in the Sieg district, in Germany. Comparing American iron ores with German, and taking into account the higher percentage of iron in the former, it is found that their average price is decidedly lower than that of the German ores.

Four States—Pennsylvania, Ohio, Illinois, and Alabama—produced 85 per cent of the pig iron in the United States in 1901, and Pennsylvania alone produced over 46 per cent. On comparing the location of the iron furnaces with that of their raw material, it will be found, that, with the exception of some of the iron works in the Southern States, their geographical situation is not favorable. This is not so striking in the case of fuel, although even that has to be carried a greater distance, on the average, than in Germany. Pittsburg, the headquarters of the iron industry, is comparatively near its coal and coke supplies, which include those of the famous Connellsville coke region, but a large portion of its iron ore has to be brought all the way from the upper end of Lake Superior.

The railway freight rates per ton mile, in Germany, are higher than in America, but, as the average haul in the former country is shorter, there is not so much disparity in the total transportation charges. But the water route through the Great Lakes, with the specially-constructed railroads for conveying the ore from the mines to the upper lake ports and from the lower lake ports to Pittsburg, and with all the labor-saving machinery for handling ore, has a most important influence on the American iron industry, and it is very questionable whether the Minnesota ore could stand all-rail transportation to Pennsylvania.

In general, it may be said that the American pig-iron industry possesses excellent raw materials, which are produced very cheaply. Fuel is delivered to the furnaces at a considerably lower cost than in Germany, and the unfavorable geographical location of the ore mines is compensated for by very cheap transportation. The cost of the ore delivered at the works is, however, not much different from that in Germany. Leaving out of consideration temporary setbacks, due to business depression, about the only thing that could endanger the supremacy of the American iron industry would be the failure of its raw-material supplies, and although estimates have been made that some of the richest fields, such as the Connellsville coke district and the Mesaba ore ranges, will be exhausted in a generation or two, it is but reasonable to suppose that within the vast territory of the United States other fields will be opened, which will continue to supply all the material needed for the production of iron and steel for centuries to come

THE MOUNT VESUVIUS RAILWAY.

A COMBINED ADHESION, RACK AND CABLE RAILWAY, ELECTRICALLY OPERATED, UP THE SLOPES OF MOUNT VESUVIUS.

E. Strub—Schweizerische Bauzeitung.

FOR nearly a quarter of a century there has been a cable railway up the cone of ashes which forms the summit of Mount Vesuvius, but to reach the foot of this railway it has been necessary to take a long and tiresome stage ride from Naples. It is therefore not surprising that Messrs. Th. Cook & Son, the well-known tourist agents, who have owned the cable railway since 1887, have long had in view projects for making the crater of the volcano more accessible.

One of the plans proposed was to build a standard-gauge steam railway from Naples to Resina, at the foot of the mountain, and from there have a rack railway, on the Abt system, up to the foot of the cable road. But this project was not well adapted to either the topographical or the traffic conditions, and, besides, its cost, about 4,000,000 francs, was prohibitive. Time went on, and yet no satisfactory plans were submitted, until just before the expiration of the concession which the Messrs. Cook had acquired, they consulted with Herr E. Strub, of Zürich, and after a brief survey

of the situation he offered a solution of the problem, which appeared so promising that he was commissioned to prepare the detailed plans on which the road was afterwards built. This railway has just been placed in operation, and a short account of some of its leading features is taken from a recent article by Herr Strub, in the *Schweizerische Bauzeitung*.

Herr Strub's project called for an electric railway from Resina, which is built on the ruins of Herculaneum, on the Bay of Naples, at the foot of Vesuvius, to the beginning of the cable road. Part of the electric railway was to be a rack road, with a special locomotive, but most of it was to be an ordinary adhesion road, with self-propelling cars. This plan seemed all the more reasonable, as an electric railway was already running from Naples to San Giovanni, only a short distance from Resina, to which it was sure to be extended in the near future. The traffic conditions also pointed to an electric road with single cars. Vesuvius is visited annually by about 12,000 persons, the highest record for one day, since the installation of the old cable railway, being 300, and, although the increased facilities will doubtless augment this number, the traffic would not be heavy enough to warrant a steam road with long trains. Another important consideration is the danger to which any structure on the slopes of a volcano is necessarily exposed, and it would not be justifiable, therefore, to expend large sums on such a permanent way as a steam road requires. The electric railway, however, with its comparatively light roadbed and its easy adaptability to grades and curves, is peculiarly fitted for such mountain work.

The railway starts from Resina and runs 3,150 meters to the power station and car shops, at the foot of the hill on which the observatory stands. The rack railway, 1,650 meters in length, rises 344 meters and carries the line up to the observatory, at an altitude above sea level of 594 meters, and the third section of the road, which, like the first section, is an adhesion railway, runs 2,700 meters from the observatory to the the foot of the cable road. The length of the road is, therefore, 7.5 kilometers (4.7 miles), not including the cable railway. The gauge is 1 meter; on the adhesion portions of the line, the minimum radius is 50 meters, and the maximum grade, 8 per cent.; the rack railway has a minimum radius of 80 meters, and a maximum grade of 25 per cent.

The road is so well located that it runs on the natural surface most of the way, the cuts and fills are reduced to a minimum, and there are no bridges. The material for the small amount of masonry construction necessary was right at hand, in the form of lava and puzzolano.

The track consists of steel rails, weighing 40 pounds to the yard (20 kilograms per meter), laid on oak ties, and with angle-iron joints. As the rails are used for the return circuit, the joints are "bonded" by the Brown-Boveri system, in which a conducting and rust-preventing metallic paste is spread between the polished surfaces of the rails and the fish plates. The rack rail is constructed on the Strub system, and is similar to the one on the Jungfrau road. It is in 3.5-meter (11.5-foot) sections and is abundantly strong to resist any stresses to which it may be subjected.

The cars weigh 8,400 kilograms each, have two fixed axles, and have a seating capacity of 24, with room on the platforms for 6 more persons. On each axle there is an electric motor of the usual tramway type. There are two independent methods of braking: Hand brakes and electromagnetic brakes. The latter consist of eight electromagnets, placed side-by-side right above the rails, between the front and rear wheels on each side of the car. Each electro-magnet has a shoe at its lower end, and adjacent magnets have different polarities, there being thus seven magnetic circuits, closed through the rail, so that a powerful braking action is effected.

The rack-rail locomotive weighs 10,400 kilograms, and is able to haul a load of 11,000 kilograms up the maximum grade of 25 per cent. at a speed of 7 or 8 kilometers an hour. It has two shunt-wound motors, of 80 horse power each, which make 650 to 700 revolutions per minute, and are both geared to the toothed wheels which engage with the rack rail. The locomotive has four wheels, and is provided with an elaborate system of both regular and emergency brakes, some of which are automatic in their action. When the cars reach the

rack section, their own trolley pole is pulled down, and they are picked up by the locomotive and hauled to the end of the rack railway, after which they proceed by their own power.

The prime movers at the power station are two 100-horse-power gas engines supplied with Dowson fuel gas, which is made on the premises. The two electric generators are shunt-wound, direct-current machines, which have each a maximum current output of 137 amperes, at 550 volts. A storage battery, with a capacity of 256 ampere hours, takes care of load fluctuations and provides a reserve of power.

On the adhesion sections of the road there is one trolley wire, and on the rack section are two, but the latter are in parallel and are used on account of the greater amount of current needed there. All these wires are of hard-drawn copper, 8 millimeters in diameter.

The total cost of this road, including right of way, power station, rolling stock and everything else, was only 1,154,000 francs ($223,000), or 154,000 francs per kilometer ($48,000 per mile). According to Herr Strub, this is by far the cheapest mountain railway that has as yet been built.

This main part of the road is now in operation to the foot of the old cable railway, and it is proposed to remodel the latter, raise its roadbed so as to avoid interruptions due to volcanic dust clogging the track and the cable pulleys, and equip it electrically. The cable road rises 388 meters in a horizontal distance of 720 meters, and so has an average grade of 54 per cent., with a maximum grade of 63 per cent. It terminates in the vicinity of the old crater, at an altitude of 1,182 meters, and about 100 meters below the present active summit crater. The estimated cost of the renovation of the cable railway is 160,000 francs ($31,000), or about one-third the cost of the old cable road.

When a small stretch of electric railway along the shores of the Bay is completed, it will be possible to ride from the center of Naples to the summit of Vesuvius, in a short time and with the greatest comfort and although this method of reaching the crater may not possess the romantic charm of a climb on foot, there is no doubt that it will be far more appreciated by the mass of tourists.

ELECTRIC HAULAGE ON CANALS.

THE FABRE-GANZ SYSTEM FOR HAULING CANAL BOATS BY MEANS OF AN ELECTRIC LOCOMOTIVE.

Julius Szász—Zeitschrift für Elektrotechnik.

FOR many years, canals in the United States have not received the attention they deserve, but in Europe, in spite of the competition of the railroads, they have continued to do a large business, and while many new waterways have been constructed and are being planned, an effort has also been made to improve the old canals so that they can meet modern requirements.

One of the most pressing improvements needed is in the tractive system. From an economic standpoint, the horse and mule are as much out of place on the towpath as in the city street, and in the former case, as in the latter, electricity appears to offer the best substitute.

A great many electric systems for canal-boat haulage have been experimented with, and there are some in successful operation on European canals, but no one of them seems to be entirely satisfactory. A recognition of this fact led to a prize competition for canal-haulage systems which was instituted by the commission charged with the construction of the Teltow canal, which is to connect the Havel and the Spree rivers, near Berlin.

This canal is 37 kilometers long, and will have a yearly traffic amounting to 4,500,000 tons, so that the conditions to be met are rather exacting. Twenty competitors offered plans to the commission, three of which received prizes, and two others, which possessed specially interesting features, were bought outright. One of the latter was the design submitted by Ganz & Co., of Budapest, which embodies some novel ideas, and which is of interest from both a technical and an economic stand-

point. This system is described in a recent article by Herr Julius Szász, in the *Zeitschrift für Elektrotechnik*, from which a brief abstract is made.

Among the systems most in use hitherto are those in which an electric automobile runs on the towpath, without any track, and obtains its current from an overhead wire or from storage batteries. Such an automobile deteriorates rapidly, owing to the wear and tear of running on an uneven path, the tractive effort required is great and the operating and maintenance expenses are high. Moreover, the driver is obliged to devote all his attention to the steering of his machine, and there is a great deal of trouble experienced at bridges. Some of these difficulties are overcome by the use of a track on which the locomotive runs. But an ordinary two-rail track involves a large outlay, and unless the locomotive is made excessively heavy the adhesion is too small to get sufficient traction.

Realizing these many difficulties, the Ganz Company, by working out the ideas of M. Fabre, has developed a system which it is believed will satisfy all technical requirements and is, besides, economical to instal and to operate. A single rail is used, and on it runs a locomotive which, instead of the usual horizontal axles, has two pairs of inclined axles. Each axle carries a wheel, and each pair of wheels embraces the rail head, which has an appropriate section not differing much from that of an ordinary T rail. In order to preserve the equilibrium of the locomotive, it has a broad-tired wheel on the side nearest the canal, which runs on the towpath. By this arrangement of the inclined wheels, the pull of the tow line increases the adhesion, which is also augmented by weight of the locomotive producing a wedgelike action on the inclined axles.

The locomotive can be very light, for an increased load on the tow line increases the adhesion. It is operated by a three-phase motor, and current, at a presssure of 500 volts, is taken from two overhead wires, on which runs a small trolley carriage, by means of flexible cables. The rail serves as the third conductor.

At loading stations the tow line is led from the locomotive to a small car, which runs on strong steel cables stretched above the towpath at a height of 10 or 12 meters, and from this car it is carried almost horizontally to a towing mast on the canal boat, thus clearing obstructions. There are many interesting details in this and other parts of the project, which have been carefully worked out, and for which the original article should be consulted. The estimated costs of the installation and operation are remarkably low, and there seems every reason to believe that this system will go a long way toward solving the problem of economical canal traction.

IRRIGATION AND WATER RIGHTS.

THE RECLAMATION OF THE ARID LANDS OF THE WESTERN UNITED STATES, AND THE LEGAL RIGHTS TO THE USE OF WATER FROM STREAMS.

Iron Age—Trans. Assoc. Civ. Engineers of Cornell University.

WHILE the "Great American Desert" of the early geographers has proved to be largely a myth, and much of the territory formerly believed to lie within its borders is now a thriving agricultural region, there yet remains a great deal of land in the western part of the United States where the soil is excellent, but where the rainfall is so slight and uncertain that no crops can be grown.

As the public lands with an adequate natural supply of water have become occupied, homeseekers have taken up some of the arid lands and have made a fair beginning in cultivating them with the aid of water diverted from the neighboring streams or led down from reservoirs in the hills by means of ditches. Somewhat later, corporations began to build irrigation plants, and a large amount of capital is now invested in such enterprises.

It has been felt, however, for several years, that this work should not be left to either individuals or companies, with all their varied and conflicting interests, but that the question of irrigation was properly one of national concern. After some discussion, this feeling has taken definite form

in a law passed by Congress about a year ago, and known as the Newlands Irrigation Act, its author being Representative Newlands, of Nevada.

According to an appreciative editorial in the *Iron Age*, "this act provides that the income from the sale of public lands shall be set apart in the Treasury as a separate account, known as the Arid Land Reclamation Fund. It will be swelled from the proceeds of the sale of mining, timber and stone lands, as well as of the arid lands themselves. Judging from the experience of the past three years it should average about $3,000,000 per annum. From the fund thus accumulated the Secretary of the Interior may draw the cost of constructing the irrigation works agreed upon for the reclamation of arid lands. He is authorized to make contracts for such undertakings up to the amount of the fund in the Treasury and unappropriated. To start the work the proceeds from the sale of public lands for the two years preceding the passage of the Newlands act were made available for this purpose, thus permitting immediate undertakings to the cost of $6,000,000. The most interesting feature of this plan is that no part of the expenditure of the Government for irrigation is a gift to the settler. Each project undertaken is automatically self-sustaining. Under each contract undertaken by the Secretary of the Interior the settlers who avail themselves of the advantages created are obliged to pay into the fund, in ten equal installments, such proportion of the cost of the irrigation plant as may be assessed upon the land they take up.

It is not alone necessary to provide the water, however; it must be equitably distributed, and this is a more difficult task than any of the engineering features of irrigation. In the comparatively small area that has been irrigated by private enterprise, there have already been numberless disputes and a multitude of lawsuits over water rights, and there are so many new and complicated questions involved that it will take the wisest legislation, the most equitable judicial decisions and a strong altruistic feeling in the community to avoid a great deal of trouble.

In a lecture delivered before the College of Civil Engineering of Cornell University, and published in the *Transactions of the Association of Civil Engineers of Cornell University*, Mr. Elwood Mead, the Chief of Irrigation Investigation, United States Department of Agriculture, goes into the subject of water rights and shows its far-reaching importance. He says that in Wyoming, "streams are declared to be the property of the State. Any one wishing to divert them must secure a permit from a State board of control. The record of water filings are as carefully kept as the record of land patents. Of the holders, the first in time has the first right; the second in time, the second right; and so on down the list. A State officer called a water commissioner, regulates the headgates of the ditches to protect these rights. When the supply begins to fail, the last ditch built is the first to be closed, so that rights on the same stream differ greatly in value according as they are of early or later date. The water commissioner is therefore the most important officer with whom the farmer comes in contact. He prevents waste, keeps the ditch owners posted as to the volume in the river above and the volume being taken out, and farmers can go on tilling their fields without having to give half their time and all their thoughts to what is being done under other ditches.

"Only a few of the arid States have, however, gone as far as Wyoming in the establishment and protection of water titles. In many of the States, no sort of supervision is exercised over the location or construction of ditches. Any one can divert water from a stream and when there is a shortage the contest over control is fought out in the fields or in the courts."

One of the water-right problems which still awaits a solution is the adjustment of the needs of irrigation to the common law doctrine of riparian rights; another is the extent to which the use of water in irrigation may be permitted to interfere with navigation rights; there are many more, but enough has been said to show the need for the best thought and effort in the settlement of these questions. It can be confidently predicted, however, that these problems will be solved by the strong common sense and good feeling of the people, who will then enjoy the full benefits of the work of legislators and engineers.

THE MAINTENANCE OF MACHINE-SHOP PERSONNEL.

THE APPRENTICESHIP SYSTEM AS ESTABLISHED IN THE WORKS OF THE BROWN & SHARPE COMPANY.

The Iron Age.

THE modern era of what is sometimes called "American" shop practice—the policy of specialization and intensification of work and of the maximum development of mechanical (as opposed to manual) function—is still so young that it has scarcely yet reached the period of the decline and passing of the first generation of workers. To a large extent the shops even of the United States are manned by employees who were trained under the old "all-round" system—or, at least, the problem of the new supply of workers has not become an insistent and vital one, except to the wider vision of some few thinkers. Amonst these there is wide diversity of view and opinion. Mr. H. F. L. Orcutt, in closing his comparative study of European and American machine-shop practice, which appeared in this Magazine in 1899, and has become one of the leading classics in the new mechanical literature, became frankly pessimistic as to the future under the new order. "How to mitigate the incapacitating effects of routine work," he said, "is one of the coming industrial problems." But Prof. Milton P. Higgins—equally fitted by personal knowledge of the daily life of the shop to estimate the tendencies of the times and the influence upon the workers—sees nothing "incapacitating" in the routine—nothing, indeed, but inspiration and uplift. To quote from his article upon "The Influence of Intensified Production" in our Works Management Number: "Let him (the workman) see that there is infinite beauty in every mechanical movement and wonderful interest in every function, that its conception, comprehension, and perfection is the highest work of man, and that the shaping of a perfect screw-head or the production of a faultless pin point is a thing of beauty and a source of enjoyment. Show him the infinite relation of his personal daily toil and duty to all the other great and beautiful things of the outer life of the universe. This is all possible so far as our industrial system is concerned. The capacity of the workman is our only limitation—and what other system can possibly reach down so low and so kindly? If this be true, how can we say that our system is degrading or oppressive upon the masses of workmen because each one must be a specialist and do his particular work better than any other?"

But there remains the practical question just how the new material—or, rather, personnel—is to be received into the shop, and that it is also a very pressing question is beginning to be recognized by some of the larger works. This is well put in a paper read by Mr. William A. Viall before the convention of the National Machine Tool Builders' Association at Worcester, Mass., and reprinted in the *Iron Age*.

"If our beloved President," says Mr. Viall, "is impressed with the fact that certain classes of our people are guilty of race suicide, what would be his opinion regarding the machine tool builders? It seems as though but little, comparatively speaking, has been done toward preparing and fitting for our shops men to take the place of those who are passing from us. All larger manufacturers are undoubtedly constantly beset with requests to recommend men for some of the smaller shops, and men are wanted for all positions, including managers, foremen, and operators of special machines. While all of us are able to make more or less prompt deliveries on machine tools and to manufacture them without limit, we are not able to supply men.

"I appreciate the fact that the tendency of to-day is very largely to specialize among machinists, as well as among professional men, and there may be a feeling among some that there is not the demand for the all-round man that there has been. But I believe there is to-day a demand and an absolute necessity for a large number of these thoroughly trained men—men from whom we can select our foremen and heads of departments. In our own case [that of the Brown & Sharpe Company], we have consistently followed the system, and the result has been that we have been able to

man our shop in its managerial departments very largely—in fact, almost entirely—with men who have been trained with us as apprentices. The technical school is doing a training that will furnish, in many cases, engineers, but it does not pretend to give the technical training that is necessary to give us the workmen that we need, and without workmen we can hardly obtain the results that we are endeavoring to obtain."

Mr. Viall then outlines the old apprenticeship system, which, of course, was largely the establishment of a personal relation impossible under modern conditions. The plan of his company is to have the boys regularly indentured, use being made of a printed form which is signed by the apprentice, his parent or guardian, and the company. Mr. Viall continues:

"As to age, we find the limit 16 to 18 to be a period that admits of their finishing their course before they have become too far advanced in age and consequently less amenable to instruction and discipline. That they must be physically sound goes without saying, for it is purposeless to train up young men who are not going to be able-bodied, as the time given to them is entirely lost. We have been obliged to pay some attention to education. I well know that it is not necessary for a good machinist to be able to know when Washington crossed the Delaware or when the Louisiana Purchase was consummated; but if we are to bring up a class of young men who are to be true representatives and men from whom we can draw our foremen and managers, they must have some idea of learning and a love for study. We have required the equivalent of our grammar school course, which presupposes that they know enough of mathematics to know the rule of three, have some idea of decimals, the metric system, etc. Like any education, it is not so much what the boy knows that we are looking to as it is to what he has been trained to, which makes him a much more apt pupil in the shop.

"Very often we are approached by young men who think they want to learn a trade, and their parents wish to have them, who would be utterly unfit for such a work and really have no idea what it means. To indent such a person would be unjust to all parties, and we therefore have provided a term of trial, consisting of 480 hours. If during this time we consider that we wish the young man and he wishes to stay with us the papers are then signed, and these 480 hours are reckoned in with the first year's time. The apprentice must complete 295 days of actual work in a given year before he can start upon the year following, and his pay is regulated strictly according to this record. The company reserve the right to make such adjustment in the apprentice's time as they may see fit by reason of a difference in running time, as for example, short time or unforeseen breaks.

"As to the prices paid, 6, 8, 10 and 14 cents per hour for the respective years, I would say that in addition to this from time to time the apprentices are allowed to have piece work to help them to make whatever they can over and above their regular pay. The work is divided practically as follows:

		Weeks.
First year.	Lathe work: Tools—	
	Single	40
	Double	10
Second year.	Drilling	6
	Milling	12
	Assembling	26
	Erecting	6
Third year.	Erecting	20
	Screw cutting	10
	General work	20
Fourth year.	General work	35
	Scraping	3
	Planing	12
	Total	200

"It is necessary to consider the work that is done, as in any educational system. It is not possible to turn out men who are finished products in any one line, but it does give the apprentices an idea of the general run of work, so that they are able to take hold and specialize later should conditions require it.

"One element that I believe is quite essential is that some one person should have charge of the apprentices. Under the old system every boy was taught to do a piece of work as the one who had him working for him saw fit to teach him. As to the grinding of tools, the drilling of centers and like work, there would be as many different ways of doing it as there were men who had

the apprentices in charge. And apprentices are often neglected because the foreman or some other person is too busy to attend to them. Given an instructor of apprentices, however, it is his duty to see that all are instructed in the same manner to do a given piece of work, that time is taken for it, and that it is done properly. Then the general line of work is carried out under the supervision of the various foremen. The instructor of apprentices is also able to look out for those who are away from home. When they are sick or when they may need attention outside of working hours he is at liberty to follow them up and act for the company on behalf of the parents or guardians of the boys. When the number of apprentices is small it is not feasible to have one man devote his time to this work; but I believe that a man could be selected a part of whose duties would be the care of the apprentices."

Mr. Viall recognizes that the system which is well adapted to his works might not serve equally well elsewhere, but he expresses the reasonable hope that it may contain food for thought for other manufacturers, and that it may not be long before all shops have a regularly constituted form of apprenticeship, helping to the creation of an order of competent and reliable journeymen.

NEW YORK'S TRANSPORTATION PROBLEM.

A DISCUSSION OF PLANS FOR HANDLING THE PASSENGER TRAFFIC IN AND ABOUT GREATER NEW YORK.

W. W. Wheatley—New York Railroad Club.

EVERYBODY who has occasion to go about in New York realizes that the transportation problem there is a pressing one. If this problem has not yet been solved, it is not from lack of consideration, for the subject has been written and talked about without end, numberless solutions have been proposed and the officers of all the transportation lines have been inundated with suggestions.

While the final solution of the problem may never be reached until New York passes the zenith of her career, a discussion of the various elements of the question by experts is of value in, at least, stating the problem clearly, and some extracts from a paper by Mr. W. W. Wheatly, recently read before the New York Railroad Club, may therefore be of interest.

It is estimated that at the beginning of 1903 the population of the five boroughs of New York was 3,632,000. Across the Hudson River, in New Jersey, there are communities, with an aggregate population of about 900,000, which, in a business and social sense, are practically part of the greater city of New York, and which must be included in any consideration of the transportation problem. There is, therefore, at present, a local population "of over 4,500,000 to be transported within the metropolitan territory. Combining the census figures of New York City and tributary New Jersey for 1890, and deducting the result from the combined figures for 1900 it will be seen that the increase of population in the whole territory within ten years was 1,173,880, or at the average rate of over one hundred thousand per annum. Figured in another way, the increase within 10 years was 38 per cent., or at the average of 3.8 per cent. per annum. Although the present growth seems to be equal to that of the past 10 years, the figures are assuming such large proportions it is not likely that the next decade will show a greater rate of increase than 35 per cent. Estimated upon this basis, it appears that the metropolitan population in 1913 should be a little more than six million people.

"While the growth of population has been remarkable, the growth of passenger traffic on the local transportation lines has been still more remarkable, figures showing that in each decade from 1870 to 1900 the passengers carried increased almost 100 per cent. A singular fact which has been obscerved in the case of many growing cities is that for every one per cent. increase in population there is a relative increase of about three per cent. in the passengers carried. It is facts like these which indicate the tremendous probable increase of passenger traffic which the

transportation lines of New York, and especially of Manhattan, will be called upon to handle within the next decade.

"The local transportation lines of this entire territory are now handling daily over 4,000,000 people, of which number about 2,500,000 ride in the Boroughs of Manhattan and Bronx, 1,200,000 in Brooklyn and Queens, and 400,000 on the lines just across the river in New Jersey." The average number of passengers carried each day by the surface and elevated lines of Manhattan is about 2,300,000, of which about 75 per cent. is north and south traffic. During the year 1902, about 302,000,000 passengers were carried by the East River, Staten Island and Hudson River ferries and the Brooklyn Bridge, and the average number of people from Long Island, Staten Island and New Jersey who cross the rivers and bays daily to Manhattan is estimated at 419,000, this latter figure representing one-way traffic only. Many of these passengers also use the north and south lines in Manhattan, and so add to the concentration of traffic there.

"The concrete fact upon which all transportation calculations must depend is not the number of people to be carried in a year or a day, but the number to be carried in one hour *in one direction*. The business and shopping district of Manhattan, roughly speaking, may be described as that part of the city between 23rd Street and the Battery. To this district the heavy stream of traffic flows in the morning and back again at night."

The "rush-hour" travel leaving the business district is estimated as follows: 1. To the northward by all elevated and surface lines, 142,000, or 56.8 per cent. of the total. 2. To Long Island and Staten Island by Brooklyn Bridge and by ferries, 64,000, or 25.6 per cent. 3. To New Jersey by ferries, 32,000, or 12.8 per cent. 4. To local Manhattan east and west points, not included above, 12,000, or 4.8 per cent. This makes an average total in the maximum hour of 250,000.

"With a population ten years hence in the metropolitan territory of 6,000,000, and a possible daily passenger travel of 8,000,000, it is probable that the number of people seeking quick transit from the business district between five and six o'clock each evening will be 500,000, instead of half that number as now. The last five years, since the consolidation of the several boroughs into the greater city, have been noteworthy for what has been planned. The next five years, in which many of the plans will reach completion, must always be memorable in the transit development of the city, not only for what has been accomplished, but for the additional plans that yet remain to be made and started toward execution. The problems presented a few years ago to the very excellent Board of Rapid Transit Commissioners, of which William Barclay Parsons is the distinguished chief engineer, and to the city authorities were:

"First.—To annihilate the river barriers on the east and west and furnish a more ready means of intercourse between all the boroughs of the greater city, as well as with the tributary New Jersey territory and the mainland beyond.

"Second.—To provide a comprehensive system of subways, and add to the facilities of the existing surface and elevated lines, so as to give the greatest possible accommodation to the north and south traffic.

"Third.—To provide suitable terminal arrangements and furnish a means of distributing the passengers brought into Manhattan by the new bridges and tunnels from the east and west, so that the local Manhattan lines, already overcrowded, will not have the burden of distribution.

"Fourth.—So to arrange the additional transit facilities that the local traffic, with many stops, will not retard the long haul traffic with few stops, and that the traffic of one line shall not cross at grade the traffic of another line.

The additional transit facilities now authorized, and their probable hourly traffic capacity in one direction, are as follows:

Manhattan Bridge No. 2, East River, eight tracks	92,600
Williamsburg Bridge No. 3, East River, six tracks	63,800
Blackwell's Island Bridge No. 4, East River, six tracks	63,800
Municipal Rapid Transit Tunnel, East River, two tracks	19,200
Pennsylvania Long Island R. R. Tunnel, East River, four tracks.	38,400
East River Total	277,800

Pennsylvania Long Island R. R. Tunnel, Hudson River, two tracks	19,200
New York and New Jersey Tunnel, Hudson River, two tracks	19,200
Hudson River Total	38,400
Municipal Rapid Transit Subway No. 1, four tracks, south of Forty-second Street	43,000

"In addition to the facilities already authorized, there is now before the Rapid Transit Commission from its chief engineer, Mr. Parsons, a proposal to increase the Manhattan elevated railroad facilities by the addition of five new tracks on the several divisions downtown, also a proposal to build Subway No. 2 with two tracks, from a connection with the West Side branch of Subway No. 1 at Forty-second Street, through Broadway, University Place, Wooster and Church Streets, to the Battery; also a proposal that the New York Central remove its present freight tracks from the surface of Tenth and Eleventh Avenues and other streets between Fifty-ninth Street and Houston Street and construct an elevated road along the same route with four tracks, two of which should be for passenger service, and be extended by way of West Street to the Battery. There are also proposals for the construction of an East Side branch of Subway No. 1 running north from Forty-second Street under Lexington Avenue to and beyond the Harlem River, and for other branches connecting the trunk subways at various points.

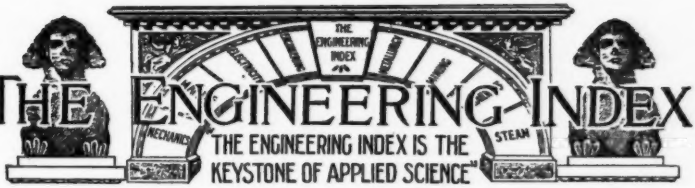
"But the real problem of transit relief relates primarily to the lower end of Manhattan. With the exception of the few bridges and tunnels which deliver the east-and-west travel direct to the business district, it is certain that the swarms of people from the other bridges and tunnels will be thrown upon the local Manhattan lines.

"If the nine additional north and south tracks proposed by Engineer Parsons were to be completed at the same time as Subway No. 1 in 1904, there would undoubtedly be felt an adequate sense of relief; but they are not yet authorized, and it will require from three to five years for their completion. Within five years it is probable that the present traffic will have increased 50 per cent. By that time the new bridges and tunnels to the east and west will have begun to pour their mighty volume of people upon the north and south lines for distribution, and there will be a continued increase in the demand for north and south transit. For every yearly increase of 100,000 in population, there is a corresponding increase of 300,000 in passengers carried. The new north and south facilities will be insufficient to give adequate accommodations."

The Long Island traffic will be far better provided for. The additional bridges and tunnels across the East River already authorized and under construction will have twenty-six tracks, with a maximum hourly carrying capacity, in one direction, of about 277,800, which, with the four tracks of the present bridge added, will give a "rush-hour" capacity of 317,800. When it is remembered that the average "rush-hour" traffic across the East River is now only 64,000, it will be seen that ample provision has been made for the boroughs on Long Island.

The two tunnels now under construction between Manhattan and New Jersey will have a maximum hourly capacity in one direction of 38,400 passengers, more than enough to take care of the present traffic, which is 32,000, though not nearly as great in proportion as that of the new East River tunnels and bridges.

A consideration of all these plans, both those already under way and those merely proposed, shows that the traffic to the northern part of Manhattan and to the Bronx is not adequately provided for. As the direction of the city's future expansion will depend very largely upon the transit facilities offered, it is conceivable that the growth of the Long Island boroughs, and even of the New Jersey suburbs, will outrun that of the northern part of the city. But no matter how many people go to the outlying territory to live, most of them will still do business in Manhattan. That island will become more and more the commercial center of the metropolis and of the whole country, and the improvement of its transportation facilities, to bear a reasonable ratio to its growth in other respects, will continue to be a problem worthy of the best engineering talent and the highest financial enterprise.



The following pages form a DESCRIPTIVE index to the important articles of permanent value published currently in about two hundred of the leading engineering journals of the world—in English, French, German, Dutch, Italian, and Spanish, together with the published transactions of important engineering societies in the principal countries. It will be observed that each index note gives the following essential information about every article.

(1) The full title,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published.

We supply the articles themselves, if desired.

The Index is conveniently classified into the larger divisions of engineering science, to the end that the busy engineer and works manager may quickly turn to what concerns himself and his special branches of work. By this means it is possible within a few minutes' time each month to learn promptly of every important article, published anywhere in the world, upon the subjects claiming one's special interest.

The full text of any article referred to in the Index, together with all illustrations, can usually be supplied by us. See the "Explanatory Note" at the end, where also the full titles of the journals indexed are given.

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BRIDGES.

Aar River.

The New Railway Bridge at Brugg, Switzerland (Die Neue Eisenbahn-Brücke bei Brugg, Aargau). An illustrated description of the present viaduct over the Aar, at Brugg, with lenticular trusses, and of proposed new designs, both in steel and in stone. 1000 w. Schweiz Bauzeitung—April 4, 1903. No. 56039 D.

Arch.

Investigation of a Pointed Arch, Pivoted at the Springings (Untersuchung eines Spitzbogens auf Zwei Festen Kämpfergelenken). Prof. G. Ramisch. A mathematical and graphical discussion of pointed arches. Diagrams. 2000 w. Zeitschr d Oesterr Ing u Arch Vereines—April 17, 1903. No. 56014 B.

Bridge Engineering.

The Field of Bridge Engineering and Essentials Necessary for Successful Practice. J. E. Greiner. An outline of the work required in the design, construction and maintenance of structures which support loads. 13500 w. Trans Assn of Civ Engrs of Cornell Univ—1903. No. 55924 F.

Concrete Arches.

Concrete Arch Bridges over the Schlitza near Tarvis (Beton Bogenbrücken über

We supply copies of these articles. See page 797.

die Schlitza bei Tarvis). Julius Stanek. A well illustrated description of two concrete arch highway bridges, of about 100 feet span, in Carinthia, Austria. 4 plates. 4000 w. Oester Wochenschr f d Oeff Baudienst—May 30, 1903. No. 56009 D.

Concrete Arch Bridge Over the San Juan River on the Road from Santiago de Cuba to Caney. Eduardo J. Chibas. An illustrated description of the rebuilding of this bridge. The old brick arch, built 50 years ago, was repaired and left, and a concrete arch added on each side to provide sufficient room for the water to pass in time of floods. 1700 w. Eng News—June 18, 1903. No. 55967.

Erection.

Raising a Steel Railroad Viaduct. Brief description of interesting engineering work on the Pennsylvania Railroad, at Becks Run, near Pittsburg. 700 w. Eng Rec—May 30, 1903. No. 55585.

Gignac.

The Bridge of Gignac on the Hérault River (Le Pont de Gignac sur l'Hérault). F. de Dartein. An illustrated description and history of a stone arch bridge in the south of France, built from 1774 to 1810, and comprising a central span of about 159 feet and two side spans of 85 feet. 5 plates. 16000 w. Ann des Ponts et Chaussées—4 Trimestre, 1902. No. 56-155 E + F.

Highway Bridge.

The Springville Bridge. Illustrates and describes details of a 143-foot steel truss bridge, carrying the highway between the towns of Concord and Ashford, N. Y. 900 w. Eng Rec—June 13, 1903. No. 55849.

Laibach.

The Kaiser Franz Joseph Jubilee Bridge at Laibach (Die Kaiser Franz Josefs-Jubiläums Brücke in Laibach). Prof. J. Melan. A well illustrated description of an ornamental highway bridge, on the Melan reinforced concrete system, in the capital of Carniola, Austria. 2 plates. 3000 w. Zeitschr d Oesterr Ing u Arch Vereines—May 22, 1903. No. 56021 B.

Raritan River.

The Raritan River Stone Arch Bridge of the Pennsylvania R. R., at New Brunswick, N. J. This bridge was planned to replace an iron bridge carrying two tracks. One-half the width of the structure has been built along side the iron bridge. The tracks are to be transferred, then the bridge completed. Illustrated description of methods of construction. 900 w. Eng News—June 18, 1903. No. 55964.

Reinforced Concrete.

Reinforced Concrete Bridge Over River Des Peres, Forest Park, St. Louis, Mo. Illustrates and describes the general details of a concrete arch bridge reinforced by corrugated square bars. 1200 w. Eng News—June 11, 1903. No. 55836.

Skew Arches.

The Stresses on Skew Arches. W. C. Kernot. Read before the Victorian Inst of Engrs. An account of an investigation made of the cause of failure in an arch of this type, at Bendigo. Gives an interesting experiment carried out to determine where the stress became intense. 2000 w. Eng News—June 11, 1903. No. 55835.

Standard Plans.

Standard plans for Bridges on the Atchison, Topeka & Santa Fe Ry. Illustrates and describes these plans and the matters governing the designs. 7800 w. Eng News—May 28, 1903. No. 55591.

Steel Trestle.

Bridges on the Eastern Illinois and St. Louis. General plan and description of the 550-ft. double track steel trestle over the Middle Fork of the Big Vermillion River and Illinois Central R. R. 400 w. R R Gaz—June 12, 1903. No. 55840.

Uganda Viaducts.

Building American Bridges in Mid-Africa. A. B. Lueder. Gives the experience of an engineer in constructing twenty-seven viaducts in the jungles. Ill. 5500 w. World's Work—July, 1903. No. 56-121 C.

Vauxhall.

New Vauxhall Bridge. A description and illustration of the present state of this structure. 1500 w. Engr, Lond—May 29, 1903. Serial. First part. No. 55682 A.

CANALS, RIVERS AND HARBORS.

Bank Protection.

Fascine Mattresses for River Beds (Die Anwendung von Grundschwellen). A. Lernet. An illustrated description of fascine mattresses, held together with cross ties, for the protection of the beds of mountain streams against erosion. 1400 w. Oesterr Wochenschr f d Oeff Baudienst—April 18, 1903. No. 56002 D.

Canal Lift.

International Competition for a Canal Lift (Internationale Wettbewerb-Ausschreibung für ein Kanal-Schiffshebewerk). Specifications for competitive designs for a canal lift to overcome a difference of level of 36 meters on the Danube-Oder canal, Austria. Plans must be submitted to the Minister of Commerce, Vienna, before March 31, 1904. 1 plate. 2000 w. Zeitschr d Oesterr Ing u Arch Vereines—May 1, 1903. No. 56018 B.

International Competition for a Canal Lift (Wettbewerbausschreibung für ein Kanal-Schiffshebewerk). Specifications for competitive designs for a canal lift with a

We supply copies of these articles. See page 797.

height of 36 meters, on the Danube-Oder canal, Austria. Competition closes March 31, 1904, with Minister of Commerce, Vienna. 1 plate. 1500 w. Oesterr Wochenschr f d Oeff Baudienst—May 9, 1903. No. 55019 D.

Croton Dam.

Progress of the Construction of the New Croton Dam. Describes the work, the changes made, present condition, &c., with portions of the construction work. Ill. 3000 w. Eng Rec—June 20, 1903. No. 55973.

The Conditions at the New Croton Dam. Editorial comment on the conditions existing at the site of this dam. 1200 w. Eng Rec—May 30, 1903. No. 55581.

Work on the Great Croton Dam. Arthur H. Battey. A review of the work, the expense, difficulties, and the plans for further increasing the water supply. Ill. 2500 w. Munic Jour Engr—June, 1903. No. 55634 C.

Dams.

The Construction of a Dam Across the Urft River, near Gemünd, Rhenish-Prussia (Vom Bau der Urft-Thalsperre bei Gemünd in der Eifel). An illustrated description of a great dam, with masonry core, designed by Prof. O. Intze, for the purpose of preventing floods, forming a reserve supply of water for irrigation, and furnishing power to a hydro-electric station. Serial, 2 parts. 1 plate. 2500 w. Deutsche Bauzeitung—March 14 and 21, 1903. No. 56071 each D.

The Spier Falls Dam of the Hudson River Water Power Company. An illustrated description of the construction of this very large dam, now nearly completed. 2 page plate. 3300 w. Eng News—June 18, 1903. No. 55968.

Automatic Drop Shutters for the Betwa Irrigation Dam, India. Herbert M. Wilson. A brief outline of the works with an illustrated description of these shutters and their action. 1000 w. Eng News—June 4, 1903. No. 55627.

See also Civil Engineering, Water Supply.

Danube.

The Lowest Navigable Depths and the Low Water Marks on the Danube between Passau and Theben, Austria (Der Niederste Schiffahrtswasserstand und die Relation der Pegelangaben bei Niedrigwasser in der Oesterreichischen Donaustrecke Passau-Theben). Hr. Lauda. A general discussion of the gauge readings and depth of water in the Upper Danube, with tables and diagrams. 2 plates. Serial, 2 parts. 7000 w. Oesterr Wochenschr f d Oeff Baudienst—May 16 and 23, 1903. No. 56006 each D.

Dortmund-Ems Canal.

The Dortmund-Ems Canal (Der Dortmund-Ems-Kanal). Johann Mrasick. An address giving a general account of this Westphalian canal. 6000 w. Zeitschr d Oesterr Ing u Arch Vereines—May 1, 1903. No. 56016 B.

Dover Harbor.

The Dover Harbor Works. Reviews the history of this project, and gives an illustrated description of the works, and methods used in their construction. 6400 w. Engng—June 12, 1903. No. 55948 A.

Dredge.

A Bucket and Suction Dredge for Monte Video, South America (Drague Marine Porteuse à Godets et à Succion, du Port de Montevideo). Ch. Dantin. An illustrated description of a large marine dredge built by Smulders, of Rotterdam. 1 plate. 1500 w. Génie Civil—May 23, 1903. No. 56151 D.

Canadian-Built Hydraulic Dredge. Illustrated description of the modern steel hydraulic dredge, J. Israel Tarte, built by the Polson Iron Works, Toronto, Ont., for the Dominion government. One of the largest and most powerful dredges ever built. 1400 w. Marine Engng—June, 1903. No. 55610 C.

Egyptian Irrigation.

The Assuan Dam and the Irrigation of Egypt (Das Stauwerk bei Assuan und die Bewässerung Agyptens). Karl Grünhut. An illustrated historical and descriptive review of projects for irrigating Egypt, and particularly of the Assuan dam. Maps. 1 plate. 3500 w. Oesterr Wochenschr f d Oeff Baudienst—April 11, 1903. No. 56000 D.

Electric Haulage.

See Street and Electric Railways.

French Waterways.

The Internal Navigation of France. Pierre Baudin. Gives a general view of the system in France and discusses the Bill introduced in Munich, 1901, to improve canals. Map. 8500 w. Contemporary Rev—June, 1903. No. 55868 D.

The Loire—Rhone Canal (Loire—Rhone Kanal). Hr. Zimmler. A review of a report to the French Chamber of Deputies by M. Andiffred on a canal to connect the Loire and Rhone rivers, and a comparison with the Danube-Moldau canal. 1000 w. Oesterr Wochenschr f d Oeff Baudienst—April 25, 1903. No. 56004 D.

German Waterways.

The Navigable Waterways of Germany (Les Voies Navigables de l'Allemagne). M. Duval. An account of the improvement of the navigable rivers and canals of Germany, and more particularly of Prussia, from 1875 to 1900, and the pro-

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ject for the future. Maps. 2 plates. 12000 w. Ann des Ponts et Chaussées—4 Trimestre, 1902. No. 56156 E + F.

Irrigation.

See also Industrial Economy.

Land Subsidence.

The Subsidence of the Land and of the Harbor Bottom at Boston. From advance pages of a report by John R. Freeman, on the proposed Charles River dam. Statement of conclusions, his proof, and reasons for the investigations are given. 1700 w. Eng News—June 18, 1903. No. 55965.

Lighthouses.

The Lighthouses in the Southern Part of the Red Sea (Les Phares du Sud de la Mer Rouge et Leur Installation). J. Benard. A description of four lighthouses recently built near the southern end of the Red Sea by French engineers for the Turkish government. Maps. 1 plate. 9000 w. Mem Soc Ing Civils de France —April, 1903. No. 56161 G.

See also Gas Works Engineering; Marine and Naval Engineering.

London.

The Port of London and Projects for Its Improvement (Etude de l'Administration Actuelle du Port de Londres et du Projet de Transformation). M. Aron. A review and an analysis of the report of a Royal Commission on the improvement of the Thames and the London docks, from both commercial and engineering standpoints. 13000 w. Ann des Ponts et Chaussées—4 Trimestre, 1902. No. 56158 E + F.

North-East Sea Canal.

The North-East Sea Canal. Describes the canal from Kiel to the Elbe and shows why it has not proved a profitable financial concern. 1500 w. Engng—June 5, 1903. No. 55796 A.

Russian Canals.

The Canals and Waterways of the Russian Lake District (Kanäle und Kanalverbindungen Russlands im Seengebiete). N. Romanow. An account, with map, of the system of waterways connecting the Baltic Sea with the Volga and other waterways in the nothwestern part of Russia. 3500 w. Oesterr Wochenschr f d Oeff Baudienst—May 16, 1903. No. 56-007 D.

Sault Ste. Marie.

The "Soo" Ship Canal System—The Fiftieth Anniversary of its Commencement. Day Allen Willey. Remarks on the importance of this canal, comparing it with other waterways, and showing the immense amount of traffic which passes through it. Ill. 1500 w. Sci Am—June 6, 1903. No. 55652.

Weirs.

Notes on Weirs in India. Gives illustrated design of examples of the three types found in Upper India. The Okhla Weir across the Jumna River; the Narora Weir at the head of the Lower Ganges Canal; the Parichha Weir in the United Provinces of Agra and Oudh. 4000 w. Engr, Lond—June 5, 1903. No. 55798 A.

CONSTRUCTION.

Borings.

East River Borings for Brooklyn Extension of the New York Rapid Transit. J. C. Meem. A record of the principal events in connection with the East River borings for the Brooklyn extension of the Rapid Transit system of New York. 5400 w. Harvard Engng Jour—May, 1903. No. 55730 D.

Buildings.

The New Schlesinger and Mayer Building, Chicago. Illustrated description of interesting construction work on a department store building. 2000 w. Br Build—May, 1903. No. 55549 C.

Construction Machinery.

See Mechanical Engineering, Miscellany.

Design.

The Effect of Design on Methods of Construction from a Contractor's Point of View. R. W. Newman. Read before the Jr Inst of Engrs. Shows how various small deficiencies in design cause the cost of construction to vary over a wide range. Ill. 2400 w. Engr, Lond—June 5, 1903. Serial. First part. No. 55803 A.

Embankments.

Embankment Consolidators. Abstracts from descriptions in *Le Genic Civil*, of two steam rollers of special form which have been employed in the construction of the Grosbois and Saint Fargeau embankments respectively. Ill. 1200 w. Engr, Lond—June 5, 1903. No. 55800 A.

Fireproof Construction.

Fireproof Building Construction. Frank W. Skinner. An outline of some types, conditions and results. 7700 w. Trans Assn of Civ Engrs of Cornell Univ—1903. No. 55931 F.

Fortifications.

Earth or Armor Protection for Seacoast Fortifications. W. Stavenhagen. Translated from *Marine Rundschau*. A study of the question whether armor or earth give the best protection. 7000 w. Jour U S Art—May-June, 1903. No. 55760 D.

N. Y. Stock Exchange.

The New York Stock Exchange. An illustrated description of this imposing building, recently erected. 1200 w. Archt's & Buildr's Mag—June, 1903. No. 55688 C.

We supply copies of these articles. See page 797.

Pipe.

The Use of Iron Pipe in Structural Work. Egbert P. Watson. An illustrated summary of its advantages and ready adaptability to a variety of ordinary structural uses, with some figures showing its comparative cheapness. 1800 w. The Engineering Magazine—July, 1903. No. 56172 B.

Reinforced Concrete.

Reinforced Concrete Construction (Betoneisenbau). Norbert Korzinek. An illustrated gener l review of reinforced concrete construction. 3500 w. Oesterr Zeitschr f Berg u Hüttenwesen—May 2, 1903. No. 56031 D.

A Re-enforced Concrete Floor Used in the Youngstown Car Barn. G. M. Scofield. Describes the construction. Discussion follows. 2800 w. Pro Engr's Soc of W. Penn—April, 1903. No. 55766 D.

Rivets.

Rivets in Structural Steel Work. C. J. Tilden. Notes differences and suggests means of comparison between theory and practice. 1800 w. Harvard Engng Jour —May, 1903. No. 55731 D.

Slope-Walls.

The Design and Cost of Slope-Walls, Including Cost of Quarrying. Describes slope-wall work, the materials used; cost of laying and of quarrying are also discussed, and data given for calculating cost. Ill. 3400 w. Eng News—June 11, 1903. No. 55833.

Steel Stacks.

Self-Supporting Steel Stacks. R. E. Newton. Gives formulae for rivet spacing and for solving the strains in the anchor rods. 1000 w. Eng Rec—June 6, 1903. No. 55718.

Structural Drawings.

Shop Detailing for Structural Steel. F. A. Mitchell. An outline of the principles to be observed in making shop drawings for structural steel work. 3200 w. Technograph—1902-3. No. 55742 D.

Tunneling.

An Interesting Example of Wide Arch Soft Ground Tunneling. An illustrated account of interesting work in building the Atlantic avenue station of the Boston subway extension to East Boston, Mass. 3500 w. Eng News—June 4, 1903. No. 55630.

MATERIALS.

Cement.

Cement—Its Manufacture, What It Is, and How to Test It. Armin Schotte. A short historical sketch, with a description of the difference between natural and Portland cement, the methods of manufacture, and the materials. 3000 w. Pro Engr's Soc of W Penn—April, 1903. No. 55764 D.

Sand Cement for Concrete Works Remote from Transportation Lines. Edward Duryee. Abstract from a paper of the U. S. Geol. Surv. An account of investigations made and the results, with report of costs. 1700 w. Eng News—May 28, 1903. No. 55592.

Portland Cement and Its Manufacture. Prof. Cambessedès in *The Brickbuilder and Cement Maker*, London. Discusses the choice of materials, methods of manufacture, properties, &c. 3500 w. Stone—May, 1903. No. 55763 C.

The Development of the Portland Cement Industry in the Lehigh Valley. Ira Judson Coe. Historical account of this industry and its growth in the section named. 2000 w. Trans Assn of Civ Engrs of Cornell Univ—1903. No. 55926 F.

Concrete.

Concrete. Acheson Smith. Considers briefly concrete arches, and the quality of concrete. Short discussion. Ill. 2400 w. Pro Engrs' Soc of W Penn—April, 1903. No. 55767 D.

Effect of Clay on the Strength of Concrete. J. J. Richey and B. H. Prater. Experimental investigations with tabulated results and general conclusions. 1200 w. Technograph—1902-3. No. 55740 D.

The Relative Strength of Wet and Dry Concrete. James W. Sussex. An account of experimental investigation. 800 w. Technograph—1902-3. No. 55739 D.

Water Tightness in Concrete. Thomas P. Roberts. A short paper citing an instance where water came through the roof of a concrete magazine, rather than through sandy loam soil descending with considerable slope, and discussing the cause. 1200 w. Pro Engrs' Soc of W Penn—April, 1903. No. 55765 D.

Iron Preservation.

Paint as a Preservative of Iron from Rust. An explanation of why the paints best suitable for preserving iron from rust are those in which the pigmental base is an oxide. 3300 w. Engr, Lond—May 22, 1903. No. 55543 A.

Iron Rusting.

The Rusting of Iron and Its Passive Condition (Ueber das Rosten des Eisens und Seine Passivität). M. Mugdan. A communication from Breslau University, giving a scientific discussion of the rusting of iron and of its passive state (when it does not enter into combinations) and the results of experiments. 7000 w. Zeitschr f Elektrochemie—May 28, 1903. No. 56060 G.

Preservation.

The Preservation of Materials of Con-

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struction. Continued informal discussion of this subject. Ill. 2300 w. Pro Am Soc of Civ Engrs—May, 1903. No. 55774 E.

Rock Powders.

The Cause of the Cementing Value of Rock Powders. Abstract of a paper by Allerton S. Cushman in the *Journal of the American Chemical Society*. Gives an outline description of the methods of preparing and testing these materials as introductory to a study of certain significant qualities. 3300 w. Eng Rec—June 13, 1903. No. 55847.

Stone.

The Testing of Building Stone. Edwin C. Eckel. Remarks on the desirability of securing uniformity in the methods of investigation, with discussion of tests by crushing, and suggestions of needed tests. 2400 w. Eng and Min Jour—June 20, 1903. No. 55995.

Structural Steel.

Soft and Hard Steel as Structural Materials (Weiches und Hartes Flusseisen als Konstruktionsmaterial). Hr. Eichhoff. Paper before the Verein Deutscher Eisenhüttenleute on the use of mild steel for shipbuilding and other structural purposes Discussion. Diagram. 4500 w. Stahl u Eisen—May 15, 1903. No. 56175 D.

MEASUREMENT.

Chronograph.

A Chronograph for Sounding (Der Sonden-Chronograph). Rudolf Reich. Paper giving an illustrated description of a chronograph for recording the instant when soundings are taken in hydrographical surveying and an account of methods for hydrographical surveying of rivers. 4000 w. Zeitschr d Oesterr Ing u Arch Vereines, April 24, 1903. No. 56015 B.

Curves.

Compound Curves (Ueber Korbbögen). Leopold Herzka. A mathematical and graphical discussion of compound circular curves. Diagrams. 3000 w. Zeitschr d Oesterr Ing u Arch Vereines—April 3, 1903. No. 56011 B.

Sounding.

A New Method of Automatic Sounding for Measuring Dredging. Brief illustrated description. 700 w. Eng News—June 18, 1903. No. 55966.

MUNICIPAL.

Fire Prevention.

The British Fire Prevention Committee and its Work. An account of the work of this committee, which includes the education of the public, to undertake independent investigations and tests of materials, methods and appliances and selected work. 2200 w. Sci Am Sup—June 20, 1903. No. 56112.

Garbage.

The Garbage Reduction Plant at Baltimore. Brief illustrated description of a plant on the Arnold-Edgerton system. 1000 w. Eng Rec—June 13, 1903. No. 55848.

Pavements.

Brick Paving in Iowa. Abstract of a recent report on the Iowa Engineering Soc giving the importance of brick paving in Iowa, and giving some of the results of investigations. 2500 w. Eng Rec—June 13, 1903. No. 55850.

Sewerage.

The Investigations of the Baltimore Sewerage Commission. Kenneth Allen. A description of projects proposed for constructing the best possible sewerage system. States the conditions to be met. Map. 6500 w. Trans Assn of Civ Engrs of Cornell Univ—1903. No. 55930 F.

A Difficult Sewer Crossing Under an Old Aqueduct in Brooklyn. Brief description of a delicate piece of engineering. A 36-inch pipe sewer was forced by means of hydraulic jacks, under the big Ridgewood aqueduct. Ill. 900 w. Eng Rec—May 30, 1903. No. 55586.

The Chicago Intercepting Sewer System. An illustrated general description of the various sections and the present conditions of the work on the intercepting sewer system. 5000 w. Eng News—May 28, 1903. No. 55587.

Street Improvement.

The Improvement of the Freie Strasse in Basel, Switzerland (Die Umgestaltung der Freien Strasse in Basel). An account of the widening and straightening of an important city street, and the necessary changes in buildings. Serial. Part I. 2000 w. Schweiz Bauzeitung—May 16, 1903. No. 56044 D.

Waste Pipes.

Standards for Waste Pipes (Normalien für Abflussröhren). Standard sizes, materials, construction, etc., of waste pipes for house drainage, recommended by the Austrian Engineers and Architects' Society. Diagrams and tables. 2 plates. 1500 w. Zeitschr d Oesterr Ing u Arch Vereines (Supplement)—April 10, 1903. No. 56013 B.

WATER SUPPLY.

Bay City, Mich.

Bay City Waterworks. E. L. Dunbar. An illustrated historical sketch. 4400 w. Fire and Water—June 23-26, 1903. No. 56145.

Detroit.

The Detroit Water Works. Clarence W. Hubbell. Historical review, with illus-

trations. 5500 w. Eng Rec—June 20, 1903. No. 55969.

Filtration.

The Filtration Works of the East Jersey Water Company, at Little Falls, New Jersey. Discussion of paper by George W. Fuller. 6000 w. Pro Am Soc of Civ Engrs—May, 1903. No. 55772 E.

Automatic Modules for Regulating the Speed of Filtration. John H. Gregory's discussion of the paper by Charles Anthony, Jr. 2500 w. Pro Am Soc of Civ Engrs—May, 1903. No. 55773 E.

On the Design and Construction of Slow Sand Filters. John H. Gregory. Discusses certain elements which enter into the design and construction of filters as viewed from the standpoint of American practice. Ill. 4800 w. Eng Rec—June 20, 1903. No. 55974.

Filtration at Philadelphia. An illustrated description of the Torresdale filters, Torresdale conduit, and Lardner's Point pumping station. 1400 w. Fire & Water—June 23-26, 1903. No. 56144.

Havana.

The Water Supply of Havana. Charles D. McDowell. An illustrated article giving an account of conditions under the Spanish rule, improvements under American rule, and needed reforms. 2000 w. Munic Jour & Engr—June, 1903. No. 55631 C.

New Orleans.

The Water Supply of New Orleans and Its Improvement. Robert Spurr Weston. Describes the conditions, showing the necessity of obtaining a more satisfactory water supply, and gives an account of the purification investigation of the water of the Mississippi River, with conclusions Ill. 5000 w. Jour N E Water Wks Assn—June, 1903. No. 55954 F.

Pipes.

Pipes and Pipe Laying for the Metropolitan Water Works. Caleb Mills Saville. Concerning the pipe system and the methods of construction employed in distributing water to Boston and its suburban cities and towns. Ill. 8000 w. Jour N E Water Wks Assn—June, 1903. No. 55957 F.

Raising Two Lines of 36-inch Pipes at the Mystic River, Somerville, Mass. John L. Howard. An illustrated description of the method adopted. 2000 w. Eng Rec—June 20, 1903. No. 55976.

Instructions to Inspectors of Cast-Iron Water Pipe, Special Castings and Stop Valves, Philadelphia. Instructions given on contract No. 28, Lardner's Point distribution system, for the improvement, extension and filtration of the water supply. John W. Hill, chief engineer. 1700 w. Eng News—June 11, 1903. No. 55834.

Pressure.

How I Reduce Pressure on a Gravity System. E. H. Gowing. Describes a scheme used at Phillips, Me., where the source of supply was about 600 feet above the general level of the village. Ill. Discussion. 2000 w. Jour N E Water Wks Assn—June, 1903. No. 55952 F.

Pumping Stations.

Management of Pumping Stations. Kenneth Torrance. Gives the system of watches at the Brooklyn Water Works, and discusses general management. 3300 w. Eng Rec—June 20, 1903. No. 55970.

The Pumping Station of the Waterworks of Olten, Switzerland (Das Pumpwerk für die Wasserversorgung der Stadt Olten). Louis Giroud. An illustrated description of an electric pumping plant for raising water from wells to a reservoir for the water supply of a small town. 4000 w. Schweiz Bauzeitung—April 11, 1903. No. 56040 D.

Past and Present Pumping Methods in the metropolitan district of Massachusetts. A. O. Doane. Showing the marked reduction in pumping expenses made possible by the introduction of the Metropolitan supply. 1500 w. Eng Rec—June 20, 1903. No. 55972.

Purification.

Water Purification Experiments at New Orleans. A report of the systems tested, the experiments made with each, and the one adopted. 2800 w. Eng Rec—June 6, 1903. No. 55719.

Water Purification. William R. Copeland. An illustrated article describing the mechanical, and slow sand filters, their operation and the advantages of each. 4000 w. Harvard Engng Jour—May, 1903. No. 55729 D.

Rates.

A Little Talk About Water Rates. John C. Chase. Considers the municipality should pay for water consumed in public buildings, street sprinkling, sewer flushing, fountains, &c., at the same rate as private consumers. Discusses a fair basis for rates, and the wisdom of conducting the water department as a business enterprise. 2000 w. Jour N E Water Wks Assn—June, 1903. No. 55955 F.

St. Louis.

St. Louis Water Supply. R. E. McMath. States the problem to be considered, discussing methods of water treatment, the probable needs of the city, sources of supply, etc., giving the writer's conclusions. General discussion follows. 28,000 w. Jour Assn of Engng Socs—May, 1903. No. 56126 C.

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Staines Reservoirs.

Engineering Conference Visits. Illustrated detailed descriptions of the Staines Reservoirs, near the Thames, and of the Great Eastern Railway Company's works at Stratford. 5800 w. Engr, Lond—June 12, 1903. No. 55945 A.

Storage.

The Echo Lake Dam, at Milford, Mass. Leonard Metcalf. An illustrated account of the construction work in raising this dam to increase the storage capacity. States fully the conditions, and gives related information. 3200 w. Jour N E Water Wks Assn—June, 1903. No. 55953 F.

Testing.

The Examination of Water (Ueber die Begutachtung des Wassers). Dr. Adolf Jolles. An address, giving a review of the various impurities of water, and of chemical analysis, biological examination and other methods of testing water. 6000 w. Zeitschr d Oesterr Ing u Arch Vereines—May 29, 1903. No. 56022 B.

Underground Water.

Underground Water. George Bowers. Suggestions on how to obtain and care for it. Followed by general discussion. 5400 w. Jour N E Water Wks Assn—June, 1903. No. 55951 F.

Water Tower.

A Very Tall Steel Water Tower. Illustrated description of the New York Shipbuilding Co.'s water tower, giving abstract of specifications. 2500 w. Eng Rec—June 20, 1903. No. 55971.

Wells.

Water Supplies from Deep Wells. F. J. Warden-Stevens. Discusses forms of deep well construction, the methods used, the supply, etc. 3300 w. Archt, Lond—June 12, 1903. No. 55867 A.

MISCELLANY.

Training.

The Training of the Civil Engineer. Extracts from an article by George F. Swain in the *N. Y. Tribune*. Considers the qualities that fit a man for success in this field, and the best preparation. 1500 w. R R Gaz—June 12, 1903. No. 55841.

ELECTRICAL ENGINEERING

COMMUNICATION.

Combined Service.

Simultaneous Telegraphy and Telephony. Charles C. Duvall. Describes a method, very simple to install, whereby a toll telephone line may be utilized for telegraphic service without interfering with telephonic communication. 400 w. Elec Wld & Engr—June 20, 1903. No. 55990.

Duplex Telephony.

Combined Telephone Circuits (Les Circuits Téléphoniques Combinés). M. Devaux-Charbonnel. A description, with diagrams, of arrangements of telephone circuits for carrying on two conversations over one circuit at the same time, and particularly, of M. Cailho's arrangement, which has operated successfully between Paris and Rouen, 140 kilometers. 3000 w. Bull Soc Internat des Elect—May, 1903. No. 56162 H.

Exchange.

The Exchange of the Ashtabula Telephone Company. Description and illustrations of the new exchange at Ashtabula, Ohio. 1200 w. Elec Rev, N. Y.—June 6, 1903. No. 55704.

Leakage.

On Electric Conducting Lines of Uniform Conductor and Insulation Resistance, in the Steady State. A. E. Kennelly. A mathematical study of the effects of leakage and resistance on currents in telegraph, telephone and other long uniform conductors. 4500 w. Harvard Engng Jour—May, 1903. No. 55-733 D.

Light Telephony.

Ruhmer's System of Light Telephony An illustrated account of what has been accomplished in this field, by Ernst Ruhmer. 900 w. Sci Am—June 6, 1903. No. 55655.

Magnetic Detector.

A Form of Magnetic Detector for Hertzian Waves, Adapted for Quantitative Work. Prof. J. A. Fleming. Read before the Royal Soc. Describes a form of detector constructed by the writer for the purpose of quantitative experiments in connection with Hertzian waves. 1600 w. Elect'n, Lond—June 5, 1903. No. 55787 A.

Pupin System.

German Tests of the Pupin System of Long Distance Telephony. An illustrated account of the experiments made by Siemens and Halske on the subterranean telephone cable, and on uncovered wires, giving in both cases very satisfactory results. 1300 w. Sci Am—June 27, 1903. No. 56146.

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Space Telegraphy.

The Development of Spark Telegraphy (Die Entwicklung der Funkentelegraphie). Lieut. Arthur Lengnick. An illustrated historical and descriptive review of the various systems of wireless telegraphy. 3 Plates. Serial. 3 Parts. 14000 w. Oesterr Wochenschr f d Oeff Baudienst—April 18, 25, and May 2, 1903. No. 56001 each D.

The Progress in Wireless Telegraphy. William Maver, Jr. A brief review of progress made. 2000 w. Cassier's Mag—June, 1903. No. 55921 B.

Recent Progress in Wireless Telegraphy. Briefly describes the patents of Reginald A. Fessenden and of Lee de Forest, granted June 9, 1903. 1700 w. Elec Wld & Engr—June 20, 1903. No. 55991.

On a New Process for Tuning Spark Telegraph Stations. Count Arco. Abstract translation from the *Elektrotechnische Zeitschrift*. Reference is made to high frequency systems only. Descriptive. Ill. 1600 w. Sci Am Sup—June 6, 1903. No. 55656.

Switchboards.

Divided Multiple Switchboards. W. Aitken. Abstract of a paper read before the Inst. of Elec. Engrs., London. Considers briefly the methods already used, and explains the system, suggested by the writer to facilitate telephone service. Ill. 2000 w. Elect'n, Lond—May 22, 1903. Serial. 1st part. No. 55534 A.

Telechirograph.

The Gruhn Telechirograph for Transmission of Handwriting. An illustrated description of the construction and operation of this instrument. 1800 w. Elec Wld & Engr—June 20, 1903. No. 55992.

Telegraphy.

Telegraphy and Telephony (Telegraphie und Telephonie). Barth Edler v. Wehrenalp. An address, giving a general review of different systems of electric communication, with illustrations. The first part deals with telegraphy. Serial. Part 1. 5000 w. Zeitschr d Oesterr Ing u Arch Vereines (Supplement)—June 5, 1903. No. 56024 B.

Telephone Cable.

The Anglo-Belgian Telephone Cable. Some particulars of the laying of this cable, the longest submarine telephone cable yet laid, as given by M. Leduc, in a recent paper. 800 w. Elect'n, Lond—June 12, 1903. No. 55880 A.

Telephone Operators.

The Training of Telephone Operators. An illustrated description of the operator's training school of the New York Telephone Co. 4200 w. Elec Wld & Engr—June 20, 1903. No. 55988.

Telephone Power Plant.

The Evolution of the Telephone Exchange Power Board. P. Kerr Higgins. An illustrated article calling attention to the changes during the last ten years, and giving suggestions for the care of the power plant. 2000 w. Elec, N. Y.—June 24, 1903. No. 56116.

Telephony.

Practical Telephone Engineering. William W. Handy. A general description of problems in the design and construction of modern telephone plants in large cities, discussing the methods that will yield the best results. 2500 w. Elec Rev, N. Y.—June 20, 1903. Serial. 1st part. No. 55934.

DISTRIBUTION.

Arc Converter.

See Electrical Engineering, Miscellany.

Regulation.

Voltage Regulation in Multiple-Wire Systems (Spannungsregulierung in Mehrleiteranlagen). Dr. Hiecke. An address, giving an illustrated description of the apparatus and methods used for measuring and regulating the voltage in the five-wire distribution system of the Allg. Oest. Elek. Gesellschaft of Vienna. 5000 w. Zeitschr f Elektrotechnik—April 19, 1903. No. 56046 D.

Rotary Converters.

The Rotary Converter. George T. Hanchett. A simple description, with diagrams, of the theory of the rotary converter for changing alternating into direct current. 2000 w. Cent Station—June, 1903. No. 55807.

Stark System.

Light, Power, Phone, and Telegraph on One Circuit. A brief description of the invention of Alexander McMartin Stark of a new system of distribution, claiming the advantages of economy and simplicity of construction and operation. 1200 w. Can Engr—June, 1903. No. 55694.

Transformers.

Standard Transformer Voltages. J. S. Peck. Read before the Nat. Elec. Lgt. Assn. Outlines the standard arrangements and the requirements they are designed to meet. 1800 w. Elec Rev, N. Y.—June 13, 1903. No. 55829.

Wiring.

The Insulation and Mechanical Protection of Electric Wiring. Remarks based on practical experience of various systems, enumerating features which may prove of assistance in determining which is the most suitable arrangement for given requirements. 2000 w. Elec Rev, Lond—June 5, 1903. No. 55784 A.

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ELECTRO-CHEMISTRY.

Accumulators.

Storage Battery Principles. Herbert L. Towle. The present article deals with the chemistry of the cell. 2000 w. Automobile—May 30, 1903. Serial. 1st part. No. 55553.

A Home-Made Storage Battery Cell. Walter G. Jones. Illustrates and describes a simple cell having a capacity of about 10 ampere-hours. 1500 w. Sci Am Sup—June 20, 1903. No. 56113.

See Electrical Engineering, Generating Stations.

Anodes.

The Wasting Away of the Anode (Das Zerfallen der Anode). Dr. Emil Wohlwill. A discussion of the phenomena taking place at the anode in electro-chemical and electro-metallurgical processes, and particularly the abnormal wasting away of the anode in the form of small particles or dust. 12000 w. Zeitschr f Elektrochemie—April 23, 1903. No. 56056 G.

Alkali Carbides.

Alkali Carbides (Ueber Alkalicarbide). Prof. Henri Moissan. A brief account of researches in the production of carbides of the alkali elements. 800 w. Elektrochem Zeitschr—June, 1903. No. 56065 G.

Calcium Carbide.

The Combustion of Carbon During the Reduction of Calcium Carbide (Ueber die Verbrennung des Kohlenstoffs bei der Calciumcarbid-Reduktion). Fr. von Kügelgen. An account of experiments on the formation of the reaction gases during the electrolytic production of calcium carbide. 2000 w. Zeitschr f Elektrochemie—May 14, 1903. No. 56057 G.

Caustic Soda.

Electrolytic Manufacture of Caustic Soda and Hypochlorites. Discusses the difficulties, and gives a brief account of a number of processes. 4000 w. Sci Am Sup—June 20, 1903. No. 56114.

Chlorine.

The McDonald Electrolytic Cell as a Chlorine Producer. Titus Ulke. An illustrated description of this cell based upon the plant in operation at the Clarion paper mill, at Johnsonburg, Pa., stating its advantages. 1200 w. Eng & Min Jour—June 6, 1903. No. 55713.

Daniell Cell.

The Electromotive Force of the Daniell Cell (Die Elektromotorische Kraft der Daniellschen Ketten). Ernst Cohen and J. W. Commelin. A communication from the Chemical Institute of Utrecht University, giving theoretical and experimental determinations of the e. m. f. of a Daniell cell under various conditions. 2000 w. Zeitschr f Elektrochemie—May 21, 1903. No. 56058 G.

Edison Battery.

The Jungner-Edison Accumulator (Der Jungner-Edison'sche Akkumulator). An article from *Elektrotechnisk Tidsskrift*, discussing the question of priority in the invention of the iron-nickel-graphite-alkali storage battery, and taking the side of the Swede, Dr. W. Jungner. 2200 w. Elektrochem Zeitschr—May, 1903. No. 56064 G.

Electric Furnace.

The Origin, Development and Applications of the Electric Furnace (Der Elektrische Ofen. Sein Ursprung, Seine Entwickelung und Seine Anwendungsformen). Adolphe Minet. A profusely illustrated, historical and descriptive review. Serial. Part 1. 5000 w. Elektrochem Zeitschr—June, 1903. No. 56067 G.

The Electric Furnace. J. Wright. A review of the development, giving illustrated descriptions of types and showing its importance to the chemist and metallurgist. 6500 w. Cassier's Mag—June, 1903. No. 55916 B.

See also Mining and Metallurgy, Iron and Steel.

Electroplating.

Anodes for Electroplating. Prof. C. F. Burgess and Carl Hambuechen. Considers some of the factors which influence the corrosion at the anode, and gives results of some measurements which have been made upon nickel anodes in a nickel-ammonium sulphate plating solution. Ill. 1600 w. Elec Chem Ind—June, 1903. No. 55618 C.

Nickel Cathodes. David H. Browne. On the phenomenon of curling up of electrolytically-deposited nickel sheets. A study of the problem of nickel-plating, with an account of experiments. Elec-Chem Ind—June, 1903. No. 55619 C.

History.

The Development and the Present State of Electro-Chemistry (Die Entwickelung und der Gegenwärtige Stand der Elektrochemie). Dr. Albert Neuburger. An illustrated historical review. Serial. Part 1. 5500 w. Elektrochem Zeitschr—June, 1903. No. 56066 G.

Iron Rusting.

See Civil Engineering, Materials.

Lead Reduction.

The Electrolytic Treatment of Galena and Reduction of Lead. Alec. A. Beadle. Describes briefly the ways in which attempts have been made to reduce galena. 1200 w. Elec Rev, N. Y.—June 13, 1903. No. 55826.

We supply copies of these articles. See page 797.

Metal Diaphragms.

Metal Diaphragms (Ueber Metalldiaphragmen). André Brochet. Communication from the Electro-Chemical Laboratory of the Ecole de Physique et de Chimie Industrielles de Paris, giving an account of experiments with metal partitions in electrolytic cells, and of their practical applications. 2000 w. Zeitschr f Elektrochemie—May 28, 1903. No. 56059 G.

Metal Production.

A Process for the Electrolytic Production of Metals (Elektrolytische Metallgewinnung). Hans Albert Frasch. An illustrated description of a process for the production of metals by converting the ores into chlorides and conveying them through a series of electrolytic baths, in which different metals are separated out at different stages. 1200 w. Elektrochem Zeitschr—June, 1903. No. 56068 G.

Ozone.

The Production of Ozone Electrically (Die Darstellung des Ozons auf Elektrischem Wege). Dr. O. Kausch. An illustrated historical and descriptive review of electric methods of producing ozone. Serial. Part 1. 1500 w. Elektrochem Zeitschr—April, 1903. No. 56062 G.

Rectifier.

A New Electrolytic Rectifier (Ein Neuer Gleichrichter). Robert Grisson. An illustrated description of an electrolytic cell, for converting alternating into direct currents, with an electrode of aluminum above a lead electrode, and a cooling coil of lead pipe in upper part of cell. 1600 w. Elektrotech Zeitschr—June 4, 1903. No. 56094 B.

United States.

Technical Instruction and Electro-Chemistry in the United States (Ueber Hochschulunterricht und Elektrochemische Technik in den Vereinigten Staaten). F. Haber. An address before the Bunsen Society, giving the results of the author's observations during his visit to the United States in 1902. The technical instruction in chemistry is discussed, and there is a review of the electrochemical industry. Tables, maps and illustrations. Serial. 3 Parts. 33000 w. Zeitschr f Elektrochemie—April 16, 30, May 7, 1903. No. 56055 each G.

Prof. F. Haber on Electrochemistry in the United States. Abstracts of lectures delivered in Germany, after a visit to America. 2500 w. Elec-Chem Ind—June, 1903. No. 55620 C.

Zinc Process.

An Electrolytic Process for Winning Zinc from Its Ores (Eine Methode zur Elektrolytischen Gewinnung von Zink aus Seinen Erzen). S. S. Sadtler. A description of a process employing an alkaline solution. 1200 w. Elektrochem Zeitschr—April, 1903. No. 56061 G.

ELECTRO-PHYSICS.

Electrons.

The Nature of Electrons (Ueber die Natur der Elektronen). Dr. Gustav Platner. A discussion of the theory of electrons as a means of explaining electric and other phenomena, with particular reference to a book by Joh. Stark on "Electricity in Gases." 3000 w. Elektrochem Zeitschr—May, 1903. No. 56063 G.

Interrupters.

The Development of the Current Interrupter. J. Wright. A review of this important accessory of the induction coil from its commencement to the present. Ill. 1800 w. Elec Rev, Lond—June 12, 1903. Serial. 1st part. No. 55878 A.

Magnetization.

Magnetization by Rapid Oscillations. Ferdinand Braun. A report of experimental investigations. 2000 w. Elect'n, Lond—May 29, 1903. No. 55674 A.

Radiography.

On the Present Status of the X-Rays. M. I. Wilbert. Reviews the history of these rays and the applications made of the discovery, showing how they have added to scientific knowledge. 6000 w. Jour Fr Inst—June, 1903. No. 55734 D.

GENERATING STATIONS.

Accumulators.

The Storage Battery in Lighting and Power Work. J. M. S. Waring. Cites various applications of a battery to lighting and power work. Ill. 1800 w. Cent Station—June, 1903. No. 55808.

Charlottenburg.

The Charlottenburg (Germany) Electric Station (Das Elektricitätswerk Charlottenburg). F. Collischon. A well illustrated description of a handsome central station, which furnishes polyphase current for lighting and power, and direct current for traction, the distributing system and methods of operation. Plans, tables and load diagrams. 3500 w. Serial. 2 Parts. Elektrotech Zeitschr—May 21 and 28, 1903. No. 56088 each B.

Chicago.

New Central Station of the Commonwealth Electric Company of Chicago. Illustrates the Curtis steam turbines to be installed in the new Fisk street station, and gives an outline of the plant. 2500 w. Ir Age—June 18, 1903. No. 55845.

Commutators.

Commutator Losses. W. B. Hird. Read

before the Glasgow Soc. of the Inst. of Elec. Engrs. A discussion of these losses and their causes, showing that some general statements assumed to be correct, are quite incorrect. 2500 w. Mech Engr—June 6, 1903. No. 55727 A.

Development.

The Development of Electric Station Power Plant. Elihu Thomson. Read before the Nat. Elec. Lgt. Assn. Reviews the development of the last twenty-five years, discusses the probable change to turbine driven plants, the possible use of internal combustion engines, etc. 2200 w. Ir Age—June 25, 1903. No. 56137.

Duluth.

Rebuilding the Duluth General Electric Company's Station. Clifford L. Higgins. An illustrated account of the changes made in remodeling. 1200 w. Elec Wld & Engr—June 13, 1903. No. 55830.

Dynamos.

Economy in Continuous-Current Dynamo Design. L. P. Purton. An analytical investigation of the problem of reducing the cost of dynamos without sacrificing efficiency. 1800 w. Elect'n, Lond—June 5, 1903. No. 55785 A.

Friction Losses.

The Determination of the Frictional Losses of Direct Current Machines (Ueber die Bestimmung der Reibungsverluste von Gleichstrommaschinen). C. Kinzbrunner. An illustrated description of a modification of the Dettmar method for determining friction losses in direct-current motors and dynamos by varying the excitation. Diagrams. 1600 w. Elektrotech Zeitschr—June 11, 1903. No. 56096 B.

Future.

The Electric Generating Station of the Future. A. W. Whieldon. Read before the Dublin Soc of the Inst of Elec Engrs. Considers the wastage that is taking place, the latest developments in the use of high-pressure currents, and suggests a studied uniformity in districts with the view to linking together scattered installations. 2800 w. Elec Engr, Lond—May 29, 1903. Serial. 1st part. No. 55678 A.

Hydro-Electric.

Valley Reservoirs as Sources of Power for Electric Plants (Talsperren als Kraftanlagen für Elektricitätswerke). Dr. M. Luxenberg. A discussion of the economy of reservoirs, formed by damming valleys, as sources of power for electric plants, with particular reference to some German examples. Diagram and tables. 3000 w Elektrotech Zeitschr—June 4, 1903. No. 56093 B.

The "Houille Blanche" Congress in France. M. F. Loppé. On the utilization of mountain streams deprived of reservoirs, and illustrated accounts of the water sheds visited by the members of this Congress. 6000 w. Feilden's Mag—June, 1903. Serial. 1st part. No. 55912 B.

Constructive Work for a Water Power Plant near Danville, Va. An illustrated description of an unusually interesting plant, including a structure entirely of concrete extending across the river a distance of about 1,219 ft. 1500 w. Eng Rec—May 30, 1903. No. 55584.

Hydro-Electric Development of the French Broad River, N. C. Charles E. Waddell. An illustrated description of a 2,250-k.w., 6,600-volt plant near Asheville, N. C. 1100 w. Elec Wld & Engr—June 6, 1903. No. 55705.

The Charles A. Chapin Electric Power Plant. An illustrated detailed description of a new hydro-electric generating station on the St. Joseph River, near Buchanan, Mich. 2500 w. Steam Engng—June 10, 1903. No. 55820.

Insulation.

Defective Insulation in Dynamo and Motor Construction. C. E. Farrington. An outline of investigations made to determine the best insulating materials. 4000 w. Cent Station—June, 1903. No. 55809.

London Tramways.

London United Tramways Power Station. An illustrated detailed description of this interesting generating station, with information in regard to the object for which this company was formed, and the area with which it deals. 2400 w. Engr, Lond—June 5, 1903. No. 55799 A.

Marine Standards.

Standards for Electric Installation on Ships (Normalien für die Verwendung von Elektricität auf Schiffen). Standards for electric light and power plants on ships proposed by the Verband Deutscher Elektrotechniker. 500 w. Elektrotech Zeitschr—May 21, 1903. No. 56089 B.

Montreal.

See Street and Electric Railways.

Nashville, Tenn.

Municipal Lighting for Nashville. Illustrates and describes a large electric lighting plant and its successful operation. 2300 w. Munic Jour & Engr—June, 1903. No. 55632 C.

Neversink, N. Y.

The Power Plant of the Neversink Light and Power Company. Illustrated description of a plant to furnish power to the towns of Monticello, Middletown and Port Jervis, N. Y. 1200 w. Eng Rec—June 6, 1903. No. 55717.

Niagara Falls.

A New Power House at Niagara Falls. Orrin E. Dunlap. Description and illus-

trations of this recently completed plant. 1200 w. Sci Am Sup—June 13, 1903. No. 55855.

Pueblo, Colo.

The Pueblo & Suburban Traction & Lighting Company, Pueblo, Col. An illustrated description of this system. 3500 w. Elec Rev, N. Y.—June 13, 1903. No. 55827.

Sheet Iron.

See Mechanical Engineering, Machine Works and Foundries.

Steam Engines.

See Mechanical Engineering, Steam Engineering.

Telephone Power Plant.

See Electrical Engineering, Communication.

United Kingdom.

"Electrical Review" List of Electricity Supply Works of the United Kingdom. Supplement. Elec Rev, Lond—June 12, 1903. Serial. 2 parts. No. 55877 each A.

Vienna.

The Vienna Municipal Electric Station (Die Städtischen Elektrizitätswerke in Wien). Hugo Fach. A paper, giving an illustrated description of a great generating station, in two parts, one for lighting, the other for traction purposes, in both of which 5,500-volt, three-phase current is generated. Map. 1 Plate. 5500 w. Zeitschr f Elektrotechnik—May 24, 1903. No. 56052 D.

LIGHTING.

Actinic Light.

Some Experiments with Actinic Light. J. W. Kime, M. D. An account of experiments made to determine which bands of the solar spectrum are rich, and which poor in the rays. The object was to gain information bearing on the use of these rays in the treatment of disease. Ill. 2000 w. Sci Am—June 20, 1903. No. 56111.

Camp Lighting.

Electric Lighting of Aldershot Camp. Gives plan, illustrations and description of this undertaking, which includes not only the generating station and distributing network, but also the barrack and building lighting, and some street lighting. 2500 w. Elec Rev, Lond—May 29, 1903. No. 55675 A.

Incandescent Lamps.

Some Points with Regard to Electric Lighting by Incandescent Lamps. Considers briefly some causes of troubles, and means of possibly increasing their efficiency. 1000 w. Elec Engr, Lond—June 12, 1903. No. 55876 A.

Nernst Lamps.

Recent Experiments with Nernst Lamps (Neuere Untersuchungen über die Nernstlampe). Dr. W. Wedding. Paper before the Elektrotechnischer Verein, giving an illustrated account of duration tests of Nernst lamps, the latest model of Nernst lamp, and a comparison between Nernst and arc lamps for small currents. Diagrams and tables. 3000 w. Elektrotech Zeitschr—June 4, 1903. No. 56095 B.

New York Municipal.

Estimates for an Electric Plant for Public Lighting in New York City. Gives the report of Dr. Cary T. Hutchinson on the cost of building and operating a plant to furnish 10,000 arc and 160,000 incandescent electric lamps for lighting the streets, public buildings and places of the boroughs of Manhattan and the Bronx. 2800 w. Eng News—May 28, 1903. No. 55590.

Train Lighting.

The Electric Lighting of a Few Steam Trains of the Prussian Railroads. Abstract of a paper presented at the German Engrs.' convention by Privy Councillor Wichert. Considers individual car lighting, and general train lighting, comparing the two systems, and describes the experimental equipments of the latter system put on two trains in general service. Ill. 7800 w. Ry & Engng Rev—June 13, 1903. No. 55819.

MEASUREMENT.

Aging.

The Aging of German Sheet Iron (Ueber das Altern Deutscher Eisenbleche). Dr. Georg Stern. An account of extensive experiments, made for several years at the works of the Union Electric Co., on the magnetic properties of sheet iron of German manufacture, suitable for transformer cores. Tables and diagrams. 2500 w. Elektrotech Zeitschr—May 28, 1903. No. 56091 B.

A Contribution to the Subject of Aging of Sheet Steel. Thomas S. Allen. An account of tests made to determine whether heating would cause any appreciable increase in the hysteresis loss of commercial sheet steel for armature construction. 1100 w. Elec Wld & Engr—June 20, 1903. No. 55989.

Calibration.

Description of Set for the Calibration of Ammeters and Voltmeters. Fred. Anson Sager. A description of the Crompton potentiometer and its accessories used in the department of Physics at the Univ. of Illinois for the purpose of calibrating direct current ammeters and voltmeters. Ill. 2700 w. Technograph—1902-3. No. 55738 D.

Dynamometer.

An Electric Instrument for Measuring Couples, Power and Work (Mesureur Electrique du Couple, de la Puissance et

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du Travail Mécanique, de MM. Gaiffe et Gunther). M. Gaiffe. A paper giving a description of an electric apparatus for quickly and conveniently observing the indications of a transmission dynamometer, designed by MM. Gaiffe and Gunther. 1000 w. Bull Soc Internat des Elect—May, 1903. No. 56163 H.

Giorgi System.

The Giorgi System of Units (Das Giorgische Masssystem). Fritz Emde. An explanation and discussion of the system of units proposed by Giovanni Giorgi, and of particular convenience and consistency for electrical measurements. Tables. 3000 w. Zeitschr f Elektrotechnik—June 7, 1903. No. 56054 D.

Magnetic Force.

On the Measurement of Magnetic Force. G. F. C. Searle. A brief account of a method of using a millivoltmeter to indicate directly the magnetic force due to the magnetizing current. 800 w. Elect'n, Lond—June 12, 1903. No. 55879 A.

Ondograph.

Differential Ondograph (Ondographe Différentiel). E. Hospitalier. A description of an improvement in the author's apparatus for recording rapidly varying periodic electric plenomena, particularly alternating current waves. 800 w. Bull Soc Internat des Elect—May, 1903. No. 56164 H.

Oscillograph.

A Portable Oscillograph for Alternating Currents. An illustrated description of the Duddell portable oscillograph, with data relative to its sensibility, and other information of interest. 1500 w. Sci Am—June 20, 1903. No. 56108.

Resistances.

Methods of Combining Resistances. Edwin F. Northrup. A summary of methods which have been used, with descriptions of some new useful ones. 1700 w. Elec Rev, N. Y.—June 20, 1903. No. 55933.

Watt-Hour Meters.

Report of the Reichsanstalt on Schuckert Meters (Mitteilungen der Physikalisch-Technischen Reichsanstalt. Bekanntmachung über Prüfungen und Beglaubigungen durch die Elektrischen Prüfämter). A report and certification from the Reichsanstalt, Charlottenburg, Germany, giving an illustrated description of Schuckert watt-hour meters for direct current. 1600 w. Elektrotech Zeitschr—May 21, 1903. No. 56087 B.

POWER APPLICATIONS.

Coal Mine.

Electric Plant at the Simson Mine of the Rossitz Mining Company, at Zbeschau, near Brünn, Austria (Elektrische Kraftanlage am Simsonschacht der Rossitzer Bergbau-Gesellschaft in Zbeschau bei Brünn). Jaroslav Jicinsky. An illustrated description of a three-phase electric power plant for a coal mine and coal washing and coke oven plant. 1 Plate. 2500 w. Oesterr Zeitschr f Berg u Hüttenwesen—April 25, 1903. No. 56028 D.

Electricity in Mines. Deals with legal questions that arise when the supply of electricity is taken from a supply company. 1800 w. Col Guard—June 5, 1903. No. 55789 A.

Electric Driving.

Electric Driving for Factories (Elektrische Kraftübertragung für Betriebszwecke). Otto Kunze. A discussion of the benefits of electric driving, the different systems, and the increased safety and health of workmen. 2400 w. Oesterr Wochenschr f d Oeff Baudient—May 30, 1903. No. 56010 D.

Applications of Electricity at the Works of Vickers, Sons, & Maxim. A. D. Williamson. Abstract of a paper read before the Inst. of Elec. Engrs. Describes a plant aggregating about 22,500 b. h. p. of generators and motors. 3400 w. Mech Engr—May 30, 1903. Serial. 1st part. No. 55663 A.

Tests of Electric Driving Equipment in the Works of the Morden Frog & Crossing Co. Miles F. Moore. Gives tests made to determine the horse-power required to drive each machine or group of machines, and the alternating-current plant installed. 1200 w. Eng News—May 28, 1903. No. 55588.

The Possible Developments of Electrical Driving in Factories Due to the Supply of Electricity at Cheap Rates by Large Power Companies. J. S. Highfield. A discussion of the important points of this subject. 2000 w. Elect'n, Lond—June 5, 1903. No. 55786 A.

Elevator.

An Automatic Electric Lift. Diagram and description of the "Richmond-Carey" press-button patent electric elevator and its working. 1700 w. Mech Engr—May 23, 1903. No. 55533 A.

Frictional Losses.

See Electrical Engineering, Generating Stations.

Heyland Motor.

An Interesting Phenomenon in Compensated Motors (Ueber eine Interessante Erscheinung an Kompensierten Motoren). Alexander Heyland. A discussion and explanation of the observed phenomenon that the rotor losses are less in "compensated" motors (with commutators on the rotor) than with ordinary induction motors. Diagrams. 1000 w. Elektrotech Zeitschr—May 28, 1903. No. 56092 B.

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Polyphase Motors with Commutators (Ueber Drehfeldmotoren mit Kommutatorankern). H. Alexander and Dr. L. Fleischmann. A theoretical discussion of polyphase motors provided with commutators in order to prevent phase shifting, and a consideration of special types of this class. Serial. 2 Parts. 4500 w. Zeitschr f Elektrotechnik—May 10 and 17, 1903. No. 56050 each D.

Iron and Steel.

Electric Power in the Iron and Steel Industries. George E. Walsh. Some notes on the improvements made through the adoption of electricity as a motive power. 1800 w. Elec Rev, N. Y.—May 30, 1903. No. 55594.

Machine Shop.

The Development and Use of the Small Electric Motor. IV. Applications to General Manufacturing Purposes. Fred. M. Kimball. Concluding a comprehensive series by an illustrated review of a variety of industrial, domestic, and commercial uses to which electric driving is especially adapted. Ill. 4500 w. The Engineering Magazine—July, 1903. No. 56168 B.

Group Driving of Machine Tools. J. C. Steen. Gives experience gained in equipping a new shop recently built. 1100 w. Am Engr & R R Jour—June, 1903. No. 55650 C.

Electric Driving in Machine Shops. A. B. Chatwood. Abstract of a paper before the Inst. of Elec. Engrs. On the advantages gained by the use of electricity, with suggestions. 2800 w. Mech Engr—June 6, 1903. No. 55728 A.

Applying a Motor Drive to an Old Lathe. Photograph and diagrams showing the method of adapting an old 60-in. engine lathe to a motor drive, and pointing out the utility of such an equipment and the management required to secure desirable results. 1500 w. R R Gaz—June 19, 1903. No. 55984.

Power Factor.

The Power Factor of Three-Phase Motors with Current Curves of Any Shape (Ueber den Leistungsfaktor von Drehstrommotoren bei Beliebiger Kurvenform). Alberto Dina. A mathematical discussion of the relation of the power factor to the shapes of the potential and current curves. 1200 w. Zeitschr f Elektrotechnik—May 3, 1903. No. 56048 D.

Pumping Plant.

See Civil Engineering, Water Supply.

Repulsion Motor.

A Repulsion Motor (Repulsionsmotor). Marius Latour. An illustrated discussion of an electric motor having an alternating field, wound like an armature and a rotor with commutator. 1200 w. Elektrotech Zeitschr—June 11, 1903. No. 56097 B.

Switches.

Notes on Motor-Starter Switches. A. H. Bate. Read at meeting of Birmingham Sec. of the Inst. of Elec. Engrs. Compares a few of the many forms of starting rheostats, and outlines the principles involved. 3400 w. Mech Engr—May 30, 1903. No. 55664 A.

Test Records.

Power Test of Group Drive Motors. Records of an elaborate series of tests recently made at the Roanoke shops to determine the power required by the various group drive motors for machine driving. 1500 w. Am Engr & R R Jour—June, 1903. No. 55644 C.

Variable Speed.

Alternating Current Motors for Variable Speed. W. I. Slichter. Shows that where an alternating current system is desirable variable speed can be obtained with good results. 2000 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55898.

TRANSMISSION.

Cables.

Electrical Transmission Under Land and Water. Alton D. Adams. On the use of cables in electrical transmission, discussing instances where high-voltage cables are desirable, and present practice. 2500 w. Elec Rev, N Y—June 20, 1903. Serial. 1st part. No. 55935.

California.

A Proposed Transmission for Pumping Purposes. Lewis A. Hicks. A discussion of the project suggested by J. B. Lippincott in a paper on the "Storage of Water on Kings River, California." Ill. 3800 w. Jour of Elec—June, 1903. No. 55932 C.

Montana.

Annual Address to the Montana Socety of Engineers. Joseph H. Harper. Reviews the engineering progress within the state of Montana, and discusses the advances made in power transmission and in wireless work. 8500 w. Jour Assn of Engng Socs—May, 1903. No. 56127 C.

South Bend.

The 25,000-Volt Transmission Plant of the South Bend Electric Company. Illustrated description of a high-tension power-transmission installation situated at Buchanan, Mich. 4200 w. Elec Wld & Engr—May 30, 1903. No. 55599.

MISCELLANY.

Agriculture.

Applications of Electricity to Agriculture. Emile Guarini. A study based on Continental experience, describing various forms of meteorological instruments, but more particularly applications to ploughing, threshing, the felling of timber, haulage, and other heavy work. The examples

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and cost figures are from actual installations. Illustrated. 4800 w. The Engineering Magazine—June, 1903. No. 56173 B.

Lightning Protection.

The New Earth Connections for Lightning Rods of the Austrian State Telegraph Department (Die Neuen Blitzableiter-Erdleitungen der Staatstelegraphen-Verwaltung). Robert Nowotny. An illustrated description of ground connections which consist of a network of stout wires buried in the earth, with or without coke. 3500 w. Oest Wochenschr f d Oeff Baudienst—May 23, 1903. No. 56008 D.

Speed Measuring.

Technical Notes (Technische Mitteilungen). Dr. G. Benische. An illustrated paper before the Elektrotechnischer Verein, giving descriptions of electric speed measuring apparatus, and of experiments on the division of the alternating current in an electric arc into two direct currents. 1400 w. Elektrotech Zeitschr —May 21, 1903. No. 56090 B.

GAS WORKS ENGINEERING

Acetylene Lighthouse.

The Illumination of the Chassiron Lighthouse with Acetylene Incandescent Lights (Note sur l'Eclairage du Phare de Chassiron à l'Incandescence par l'Acétylène). M. de Joly. An illustrated description of a lighthouse in France, which is lighted with acetylene gas and Welsbach incandescent mantles, and the results of its operation. 3000 w. Ann des Ponts et Chaussées—4 Trimestre, 1902. No. 56157 E + F.

Acetylene Plant.

Acetylene Gas Plant of the Great Northern at St. Paul. Brief illustrated description of a plant for producing and compressing this gas for train lighting. 800 w. R R Gaz—June 12, 1903. No. 55842.

Ammonia.

Sulphate of Ammonia Making by a New Process. J. Ballantyne. Read before the Inst of Gas Engrs. Gives interesting details of a plant at Hamilton, worked by vacuum instead of by pressure. Ill. Discussion. 5200 w. Gas Wld—June 13, 1903. No. 56135 A.

Carbonizing.

The Settle—Padfield Carbonizing Process. Gives a description of this process as explained in the English patent specification. A vertical retort arrangement. Ill. 2000 w. Jour Gas Lgt—June 16, 1903. No. 56136 A.

Carburetting.

The Self-Carburetting of Water Gas in Gas Works. Abstract translation of a communication by H. Dicke, to the *Jour für Gasbeleuchtung*. Information on the working of this process at various places. 4600 w. Jour Gas Lgt—June 9, 1903. No. 55875 A.

Future.

The Future of the Gas Industry. William Upton. Read before the London & Southern Dist. Jr. Gas Assn. Considers important questions involved in the progress of the industry. 3300 w. Gas Wld —June 6, 1903. Serial, First part. No. 55780 A.

Gas-Producer.

The Taylor Gas Producer. Illustrates and describes a producer that can be applied to any existing gas or oil engine. 800 w. Engng—June 5, 1903. No. 55797 A.

Gas Testing.

Candles and Calories. Prof. Vivian B Lewes. Read before the Inst of Gas Engrs. A discussion of the methods of calculating the illuminating and the calorific values, and of determining their average relations. 7200 w. Gas Wld—June 13, 1903. No. 56130 A.

Intensified Lighting.

High-Pressure Gas Incandescent Lighting. William Sugg. Read before the Inst of Gas Engrs. Describes improvements made in this system of lighting. Ill. Discussion includes also the papers by Mr. Marshall and Mr. Onslow. 9200 w. Gas Wld—June 13, 1903. No. 56133 A.

Later Developments in High Pressure Lighting. A. W. Onslow. Read before the Inst of Gas Engrs. Advocating the use of high-pressure gas, and giving report of success in the lighting of workshops and large spaces. 4000 w. Gas Wld—June 13, 1903. No. 56132 A.

The "Selas" System of Intensified Lighting by Means of an Admixture of Gas and Air. F. D. Marshall. Read before the Inst of Gas Engrs. An illustrated description of this system, stating its advantages, and giving results obtainable 4000 w. Gas Wld—June 13, 1903. No. 56131 A.

Lewes Process.

The Lewes Process at Tipton. Sidney O. Stephenson. Read before the Inst of Gas Engrs. An account of the Lewes process of the utilization of blue water gas on the full working scale, giving the re-

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sults. Ill. and discussion. 10400 w. Gas Wld—June 13, 1903. No. 56129 A.

Light Theory.

Why a Flame Emits Light—The Development of the theory. Prof. Robert Montgomery Bird. Gives a review of ancient ideas in regard to artificial light, and explains the "acetylene theory" advanced by Prof. Vivian B. Lewes. Ill. 4000 w. Pop Sci M—July, 1903. No. 56117 C.

Naphthaline.

Naphthaline. Dr. W. H. Birchmore. Read before the Western Gas Assn. A discussion of results of investigations describing experiments made and giving a full study of the subject. 12000 w. Am Gas Lgt Jour—June 22, 1903. Serial, First part. No. 55998.

New York.

Concentrating Gas Manufacture in New York. Notes on the mammoth works scheme being planned for New York, based on information obtained from W. H. Bradley, while on a European tour to investigate the latest practice in Europe. 2000 w. Jour Gas Lgt—June 9, 1903. No. 55872 A.

Pan-Breeze.

A Machine for Sorting and Washing Pan-Breeze. Illustrates and describes a washing and screening plant by which this work is done automatically and with economy. 1400 w. Gas Wld—June 6, 1903. No. 55781 A.

Photometry.

Photometry and Testing. Walter Grafton. Read before the Inst of Gas Engrs. Discusses the "weak spots" in the present system of testing, showing that some existing beliefs, as regards burners, are wrong. General discussion. 10800 w. Gas Wld—June 13, 1903. No. 56128 A.

The Theory and Practice of "Flicker" or Color Photometry. Jno. F. Simmance. A discussion of this subject with a description of a form of Ritchie photometer—the Simmance-Abady photometer—and an account of its use. 4500 w. Jour Gas Lgt—June 9, 1903. No. 55873 A.

Purification.

Gas Liquor as an Adjunct for the Purification of Water Gas. H. Leicester Greville. Reports results of experiments and discusses the advantages. 1200 w. Jour Gas Lgt—June 9, 1903. No. 55874 A.

Retort-Charging.

Plant for Charging and Discharging Gas Retorts. Summary of a paper prepared for the Societe Technique de l' Industrie du Gas en France, by M. P. Sarrazin, describing the apparatus and its working. Ill. 2800 w. Gas Wld—June 6, 1903. No. 55782 A.

The New Parisian Retort Charging Machine. A correction of a few inaccuracies in a previous article, with supplemental information. Ill. 1200 w. Jour Gas Lgt—May 26, 1903. No. 55621 A.

Self-Lighting Burners.

Canioni's Self-Lighting Burners. M. Auguste Lecomte. Read before the Soc Tech. du Gas en France. Introductory remarks with description of these burners and their action. 1800 w. Jour Gas Lgt—May 26, 1903. No. 55622 A.

Subaqueous Mains.

The High Pressure Gas Main Under the Mississippi River. Thomas D. Miller. Read before the Western Gas Assn. An illustrated account of the laying of a high-pressure main on the bed of the river to supply Algiers with gas. Discussion. 5800 w. Am Gas Lgt Jour—June 8, 1903. No. 55698.

Unproductive Capital.

Unproductive Capital and Its Relation to Renewals. Arthur Valon. Read before the Inst of Gas Engrs. A discussion of the difficulties attendant on over-capitalized works, etc. Discussion. 5500 w. Gas Wld—June 13, 1903. No. 56134 A.

Yield.

Maximum Economical Yield of Gas per Pound of Coal Carbonized. John Somerville. Read before the Western Gas Assn. Introducing a general discussion. Gives results from personal experience. Discussion follows. 5300 w. Am Gas Lgt Jour—June 15, 1903. No. 55817.

INDUSTRIAL ECONOMY

Automobile vs. Locomotive.

See Mechanical Engineering, Automobiles.

Commercial Management.

The Commercial Management of Factories. Ian Andrews. A synopsis of the influence and functions of the office manager in relation to the reduction of the cost of output. 3100 w. The Engineering Magazine—July, 1903. No. 56171 B.

Education.

The Potency of Engineering Schools and Their Imperfections. Dugald C. Jackson. A discussion of methods and

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their effects on students and on the public. 7000 w. Wisconsin Engr—May, 1903. No. 56124 D.

Education of Engineers and Machinists. Garret Van Arkel. Urging the higher development of the mind and the awakening of an interest in the best littrature and in history, philosophy, economics, the sciences and fine arts. 2000 w. Am Mach—June 18, 1903. No. 55959

Technical Accessories for Academic Lectures on Machine Construction (Technische Mittel für Akademische Vorlesungen über Maschinenbau). Prof. Kammerer. A description of lantern pictures, models and other helps in lectures on technical subjects to large classes. Serial. Part 1. 2500 w. Zeitschr d Ver Deutscher Ing—May 23, 1903. No. 56075 D.

Commercial Education in Europe. Reports of Switzerland, Netherlands, Austria-Hungary, Belgium, Norway and Sweden, and France, with remarks. 2000 w. U. S. Con Repts. No. 1672—June 15, 1903. No. 55757 D.

See also Civil Engineering, Miscellany.

Freedom of Contract.

The Illinois Supreme Court on Freedom of Contract for Labor. George W. Shaw A defense of the right of contract. Discussion in the case of Mathews v. the People. 700 w. Eng & Min Jour—May 30, 1903. No. 55580.

Industrial Efficiency.

The Promotion of Industrial Efficiency and National Prosperity. II. Past Hindrances, and a Suggested Modification of the American Premium system. John B. C. Kershaw. A comparative study of the influence of profit-sharing, premium and bonus system, pointing out the weakness of the first for most situations. 2600 w. The Engineering Magazine—July, 1903 No. 56170 B.

Irrigation.

Water Rights. Elwood Mead. Explains the methods by which running water, which is gathered into streams from the rains and melting snows of the mountains, is divided among the ditches and farms and is bought and sold like any other property. 3600 w. Trans Assn of Civ Engrs of Cornell Univ—1903. No. 55929 F.

Irrigation as a Factor in National Development. Editorial on the great benefit of the Newlands Irrigation Act, which has been in operation in the United States for nearly a year. 1400 w. Ir Age—June 4, 1903. No. 55598.

Kiao-Chau.

The Development of the Kiao-Chau Territory in China, from October, 1901, to October, 1902 (Die Entwickelung des Kiautschou-Gebiets in der Zeit vom Oktober, 1901, bis Oktober, 1902). A general account of railways, harbors, buildings and other development work in the German sphere of influence in China. 2500 w. Glasers Annalen—June 1, 1903. No. 56086 D.

Labor.

What Is for the Best Interests of the Workingman in His Relation to His Employer and to the Labor Union. Thomas Caldwell. A discussion of these two points in the problem of the relation of capital and labor. 4000 w. Ir Age—June 11, 1903. No. 55722.

Employer and Employee. S. H. Stupakoff. Remarks on the conditions and a wise statement of the relations and rights of each. 1200 w. Jour Am Found Assn—June, 1903. No. 55755.

The Labor Capitalist. Frank C. Perkins. Suggests that the laboring classes acquire stock in the industrial enterprises and have a voice in the management of the industries. 3000 w. Cassiers' Mag—June, 1903. No. 55920 B.

The Labor Crisis. Discusses the seeming chaos in organized labor and the disturbance in industry due to these conditions. 1800 w. Gunton's Mag—June, 1903. No. 55743.

Manufacturing Methods.

Modern Manufacturing Methods. Editorial on the methods of management demanded by modern machines if they are to prove a paying investment. 2200 w. Engng—June 5, 1903. No. 55794 A.

Peat.

See Mining and Metallurgy, Miscellany.

Piece Work.

The Piece-Work System from a Piece-Worker's Standpoint. H. B. Kepner. The first of a series of articles discussing the advantages and disadvantages of the system. 1300 w. Am Eng & R R Jour—June, 1903. Serial. First part. No. 55648 C.

Pig Iron Warrants.

Scotch Pig Iron Warrants. Editorial discussing the change which seems to be affecting the pig-iron trade in Scotland. Explains the system of storing iron, how it originated, the manner of conducting business, &c. 2800 w. Engng—June 12, 1903. No. 55949 A.

Raw Materials.

Raw Materials and Transportation Costs in the United States (Rohmaterialien und Frachtenverhältnisse in den Vereinigten Staaten). Hr. Macco. A paper before the Verein Deutscher Eisenhüttenleute, giving extensive statistics of the production and transportation costs of

coal, coke, iron ore and pig-iron in the United States, and comparisons with Germany. Maps. 2 plates. 8000 w. Stahl u Eisen—May 15, 1903. No. 56176 D.

Raw Materials and Their Transportation in the United States (Rohmaterialien und Frachtenverhältnisse in den Vereinigten Staaten). Hr. Macco. Paper before the Verein Deutscher Eisenhüttenleute, giving statistics of coal, coke, iron ore and pig iron production, cost, transportation charges, etc., in the United States, and comparisons with German figures. Tables. 7000 w. Serial. 2 Parts. Zeitschr d Ver Deutscher Ing—May 16 and 23, 1903. No. 56076 each D.

Roads.

Pennsylvania's New Good Roads Law. A copy of the Sproul bill, for the purpose of constructing good roads throughout the state, which recently passed the legislature. 5000 w. Munic Jour of Engrs—June, 1903. No. 55633 C.

Safety Devices.

Arrangements for the Protection of Workmen (Einrichtungen für Unfallverhütung und Schutz der Arbeiter). Otto Kunze. An account of safety devices and sanitary arrangements in some modern German shops and factories. 3000 w. Oesterr Wochenschr f d. Oeff Baudienst—May 2, 1903. No. 56005 D.

Works Management.

Shop Management. Fred. W. Taylor. An exhaustive treatise on some of the different systems of shop management including methods of timing the rate of work, the amount of the day's work and the methods of rewarding the laborers. 47500 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55893 D.

A Graphical Daily Balance in Manufacture. H. L. Gantt. A continuation of a former paper by the author calling particular attention to the method of setting the task and the method of operating the system by which an exact record is kept. Especially considering the operating. 3800 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55908.

A Machine Shop Problem. Charles Day. A discussion of points in connection with the equipment and management of manufacturing establishments. 5500 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55910 C.

MARINE AND NAVAL ENGINEERING.

Air Propeller.

Employment of the Air Propeller for Motor Boat Propulsion. Considers that, under normal conditions, the use of the air propeller could not be justified. 1500 w. Automobile—June 13, 1903. No. 55811.

Armored Cruiser.

The Spanish Armored Cruiser Cardenal Cisneros. Illustrations and descriptions of a re-designed ship, showing the changes made after the Spanish-American war. 700 w. Engr, Lond—June 5, 1903. No. 55801 A.

Balancing Engines.

The Balancing of Engines (Equilibrage des Machines). H. Brillié. A discussion of the theory and practice of the balancing of various engines. Diagrams and tables. 8000 w. Serial. 3 plates. Génie Civil—May 23, 30 and June 6, 1903. No. 56152 each D.

The Theory of Balancing in Its Application to the Engines of Paddle-Wheel Steamers (Die Theorie des Massenausgleichs in Ihrer Anwendung auf Radschiffsmaschinen). Alb. Achenbach. A discussion of the balancing of paddle-wheel engines, with diagrams and illustrations. 2 plates. 1000 w. Schiffbau—April 8, 1903. No. 56069 D.

Battleships.

A Comparison of the German Battleship "Wettin" with the "Maine." Fred T. Jane. Illustrates the two designs and gives tabulated details with notes. 2000 w. Sci Am—June 13, 1903. No. 55853.

H. M. S. "Commonwealth." Illustration and particulars of this first-class battleship. 1500 w. Engr, Lond—May 22, 1903. No. 55545 A.

Boilers.

See Mechanical Engineering, Steam Engineering.

British Navy.

Great Britain's Naval Supremacy. Sir Charles W. Dilke. An illustrated article giving conclusions from the recent British naval debates. 3000 w. Cassier's Mag—June, 1903. No. 55915 B.

Coal Fleets.

The Coal Fleets of the Great Kanawha River. H. C. Fithian. An illustrated article giving particulars and describing unique features. 2800 w. Marine Engng—June, 1903. No. 55608 C.

Coaling Warships.

Coaling Warships at Sea. Herbert C. Fyfe. Describes the equipment of the U. S. Battleship "Illinois" with the apparatus for coaling at sea, and gives infor-

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mation concerning experiments made by Great Britain and Russia. Ill. 1200 w. Sci Am—June 27, 1903. No. 56149.

Cup Races.

What Cup Races Cost? Editorial on the expense of defending the cup, and the amount of money spent in and around New York on account of these races, and its effect on other Atlantic seaports. 1000 w. Am Shipbuilder—June 18, 1903. No. 55941.

Destroyers.

U. S. Torpedo Boat Destroyers Truxton, Whipple and Worden. H. A. Magoun. A short description of certain features of these vessels which have successfully completed their final acceptance trials, with illustrations and general plans. Plates. 2000 w. Jour Am Soc of Nav Engrs—May, 1903. No. 55859 H.

Exploring Ship.

The Exploring Steamer "Poseidon" (Der Forschungsdampfer "Poseidon"). W. Kaemmerer. An illustrated description of a twin screw steamer built for the German government for the purpose of making scientific investigations at sea, particularly for fishery work. 1200 w. Zeitschr d Ver Deutscher Ing—June 6, 1903. No. 56079 D.

Ferryboat.

The New Ferryboat Newark. An illustrated description of the latest addition to the boats of the Pennsylvania Railroad, operated in New York harbor. 2000 w. Naut Gaz—June 18, 1903. No. 55881.

Floating Derrick.

The 120-Ton Floating Derrick for the Norfolk Navy Yard. An illustrated description of the construction and operation of one of the largest floating derricks ever built. 1800 w. Eng News—June 25, 1903. No. 56358.

Floating Drydock.

The Cavité Steel Floating Dry-dock. A. C. Cunningham. A description of this dock, giving the specifications and describing details in design and operation showing its value in defending the Philippines. Illustrations, plates, &c. 10000 w. Jour Am Soc of Nav Engrs—May, 1903. No. 55864 H.

"Grangesberg."

S.S. "Grangesberg." An illustrated description of an unusual vessel, designed for carrying ore, and fitted with twenty-four derricks. 330 w. Engrs' Gaz—June, 1903. No. 55776 A.

Ice-Breaker.

Light-Draft River Ice Breaker. Gives an illustrated description of an ice breaker for small river service, built at Danzig, Germany. 1500 w. Marine Engng—June, 1903. No. 55606 C.

"Kaiser Wilhelm II."

New North German Lloyd Express Steamship Kaiser Wilhelm II. An illustrated detailed description of this fine vessel, remarkable for its size and expensive fittings for passenger service. 2800 w. Marine Engng—June, 1903. No. 55605 C.

Lighthouse Service.

How Canadian Waterways are Lighted. Information from the annual report of Lieut. Col. F. Gourdeau, deputy minister of marine and fisheries of the Dominion government. Ill. 1800 w. Marine Rev—May 28, 1903. No. 55555.

Lighthouses.

See Civil Engineering, Canals, Rivers and Harbors, and Gas Works Engineering

Lightships.

Lightships (Les Feux Flottants). M. Ribière. A well illustrated description of several new lightships for the French coast, some with a crew and some without, the system of lighting with compressed oil gas, the sound signal apparatus, and other features. 3 plates. 7000 w. Ann des Ponts et Chaussées—4 Trimestre, 1902. No. 56154 E + F.

Marine Engines.

Marine Engine Designs. Comparative Practice, 1903. John Calder. Considers the ways in which the demand for greater power has been met, and the classes of service for which the designs must be made. Gives tabulated comparative practice. 3000 w. Marine Engng—June, 1903. No. 55611 C.

Monitors.

The Official Trial of the U. S. S. Florida. Lieut. Com. Albert Moritz. An illustrated detailed description of the vessel and its equipment, with report of trial. 7800 w. Jour Am Soc of Nav Engrs—May, 1903. No. 55865 H.

Petrol Launch.

The King's Petrol Motor Launch. Illustrations with brief description. 350 w. Auto Jour—June 13, 1903. No. 55936 A.

The King's New Launch. Illustrated description of a petrol launch built for the King of England. 1000 w. Engng—June 19, 1903. No. 56312 A.

Polar Navigation.

About Some Important Polar Navigations to High Latitudes. Dr. Arnaldo Faustini. An account of journeys to very high latitudes in the 17th and 18th centuries, with comments on their value. 3900 w. Jour Fr Inst—June, 1903. No. 55735 D.

Propeller Shafts.

Improvements in Propeller Shaft Bearings. A Scott Younger. Read before the

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British Inst of Nav Archts. A record of some experiments made and the results, with a description of some improvements. Ill. 800 w. Naut Gaz—June 18, 1903 No. 55882.

Schooner.

Six-Masted Schooner, Addie M. Lawrence. Illustrated description of this large wooden sailing vessel, built at Bath, Me. 900 w. Marine Engng—June, 1903 No. 55612 C.

Screw Propellers.

Screw Propellers of U. S. Naval Vessels. Lieut. Charles W. Dyson. Criticisms based on the findings of the efficiencies of performance of the different screws as shown by applying of Froude's formulae, using as data the actual data of the trials of the vessels. 14000 w. Plates and tables. Jour Am Soc of Nav Engrs —May, 1903. No. 55857 H.

Shallow Draft.

Improved Designs of Screw Propulsion for Shallow Draft Boats. Illustrates and describes designs by A. F. Yarrow for propelling boats in shallow water. A device for improving the efficiency of the shallow-draft boat for towing purposes is explained. 1700 w. Sci Am Sup—June 6, 1903. No. 55657.

Ship Machinery.

Engineering Life on an Atlantic Liner. Harry Cornell. A narrative of the routine of the operation and maintenance of the machinery of the steamship "St. Louis." 2000 w. Steam Engng—June 10, 1903. No. 55821.

Ship Resistance.

The Motion of Water During the Passage of Ships and Its Influence on Ship Resistance (Die Wasserbewegung Während der Fahrt von Schiffen und Ihr Einfluss auf den Schiffswiderstand). R. Haack. A paper giving a discussion of experiments on the Dortmund-Ems canal, and of the question of ship resistance particularly in canals and shallow waters. Illustrations and diagrams. Serial. 2 parts. 8000 w. Zeitschr d Ver Deutscher Ing—May 16 and 30, 1903. No. 56072 each D.

Speed and Coal.

Speed and Coal Consumption Curves. Lieut. Daniel S. Mahoney. The importance of securing these representations of the relation existing between coal consumption and speed in warships. How the curves are constructed; what they show, &c., is presented. 2800 w. Jour Am Soc of Nav Engrs—May, 1903. No. 55858 H.

Submarine.

Official Trial of the Submarine Boats "Grampus" and "Pike." Leo Morgan. Brief illustrated description, with report of trials. 4500 w. Jour Am Soc of Nav Engrs—May, 1903. No. 55866 H.

Tonnage Laws.

Tonnage Laws of the United States. Theodore Lucas. Explains how ships are measured for determining the tonnage, and considers how a saving in gross tonnage may be effected. 2200 w. Naut Gaz—June 4, 1903. No. 55697.

Turbine Steamer.

The New Turbine Channel Steamer Queen. Illustration and brief description of a channel steamer for the South-Eastern and Chatham Ry. 1200 w. Engr, Lond—June 19, 1903. No. 56329 A.

The First Cross-Channel Turbine Steamer. H. C. Fyfe. A description of a vessel now building which is expected to create a revolution in cross-channel passenger traffic. 1000 w. Sci Am—June 20, 1903. No. 56107.

"United States."

New Twin Screw Steamship United States. Illustration with brief description of this new passenger and freight steamship of the Scandinavian-American line, for the New York and Copenhagen route. 700 w. Am Shipbuilder—June 18, 1903. No. 55940.

Warships.

The Relative Importance of Offensive and Defensive Qualities in Men-of-War. Sir William Laird Clowes. A criticism of present tendencies in battleship construction, with views at various stages of the work. 6500 w. Page's Mag—May, 1903. No. 56115 B.

The Problem of Building Warships on the Great Lakes. H. C. Sadler. Discusses the possibilities of the lake shipyards and engine works with regard to governmental work, showing that in workmanship, cost of production, and speed in building there is nothing to hinder. The two obstacles being the agreement with Great Britain with regard to building warships on the Lakes, and the difficulty in getting vessels to the coast. Ill. 3300 w. Jour Am Soc of Nav Engrs—May, 1903. No. 55863 H.

Water Cost.

The Cost of the Fresh Water Used on Board of Ocean Steamers (Kosten des an Bord von Seedampfschiffen Verbrauchten Frischwassers). Franz Schneider. A discussion of the cost of fresh water for all purposes, whether distilled from sea water or carried along in tanks. 2000 w. Schiffbau—April 23, 1903. No. 56070 D.

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MECHANICAL ENGINEERING

AUOMOBILES.

Commercial Vehicles.

A. C. A. Commercial Vehicle Contest. An account of the first official trial in America of the capabilities of the commercial automobile, the motive powers being steam, gasoline and electricity. Ill. 3500 w. Automobile—May 30, 1903. No. 55552.

Glasgow-London Trials.

The Glasgow to London Non-Stop Trial. Short account of the arrival of the cars in London, with preliminary statements of the various vehicles. Ill. 1500 w. Motor Car Jour—May 23, 1903. No. 55532 A.

Hill Climbing.

Hill-Climbing at Boston, U. S. A. Hugh Dolnar. Brief account of the contest on Commonwealth Ave. hill on April 20th. 700 w. Autocar—May 23, 1903. No. 55531 A.

Lawn Mower.

A Novel Automobile Lawn Mower. Waldon Fawcett. Illustration and brief description of the automobile mower used on the lawn of the United States Capitol. 600 w. Sci Am—June 13, 1903. No. 55851.

Motor Chair.

The New Motor Chair. Illustration with description of an attractive vehicle for carrying one or two persons in comfort. A novelty shown at the British Auto Ex. 900 w. Sci Am—June 13, 1903. No. 55854.

Motor-Cycles.

What the Motor Cycle Offers. Henry Norman. Considers it the cheapest method of transportation as yet discovered, and destined to have an important effect on industrial and social conditions. 2000 w. World's Work—July, 1903. No. 56122 C.

Paris--Madrid.

Paris-Madrid. An illustrated article confined mostly to the vehicles used, the regulations, and details of interest to car users. 3000 w. Autocar—May 30, 1903. No. 55671 A.

Paris-Madrid Race. An account of this race between Paris and Bordeaux, with editorial, and many illustrations of vehicles. 9000 w. Auto Jour—May 30, 1903. No. 55669 A.

The Paris-Madrid Automobile Race. which was stopped at Bordeaux because of accidents, with illustrated descriptions of many of the cars. 2800 w. Sci Am—June 20, 1903. No. 56110.

The Paris-Madrid Motor Car Race. A discussion of this race which ended in disaster, with remarks on the instructive features in the designs, and the ability to stand the strain of such speed and the effects upon the industry. 3000 w. Engr, Lond—May 29, 1903. No. 55684 A.

The Paris-Madrid Race. An account of this race so far as run, its sad accidents, and the crowds in attendance. Illustrations of vehicles. 4000 w. Motor-Car Jour—May 30, 1903. No. 55672 A.

Petrol Cars.

The "Continental" Petrol Cars. Illustrates and describes these vehicles, which are made in Paris, and designed to be sold at a moderate price. 1100 w. Auto Jour—May 30, 1903. No. 55670 A.

Racing.

Motor Racing and Motor Records. A Retrospect. Notes on the past history of motor car racing. 1800 w. Sci Am—June 6, 1903. No. 55653.

Steel Rail.

The Automobile and the Railway as Transport Agents. Sylvester Stewart. Shows that the steel rail is even a more important factor than the locomotive in increasing the speed and safety of transit, and argues that the automobile on common roads can never be a serious rival of the railway locomotive. It is an auxiliary for specialized service, but wherever possible will be run on plateways. 3000 w. The Engineering Magazine—July, 1903. No. 56167 B.

Variable Speed.

A Petrol Car Fitted with Variable Speed Friction Gear. An illustrated description of an experimental car fitted with the friction method of transmission. 800 w. Auto Jour—June 13, 1903. No. 55938 A.

Voiturette.

The Humber Voiturette. Brief illustrated description of a small car, two-seated, to be sold for £150. 900 w. Autocar—June 13, 1903. No. 55939 A.

Weller Car.

The Weller Twenty Horsepower Car. Illustrates and describes a British car that has attracted attention. 900 w. Autocar—June 6, 1903. Serial. First part. No. 55778 A.

The Weller Petrol Cars. Illustrates and describes the interesting features of these cars. 2400 w. Auto Jour—June 13, 1903. Serial. First part. No. 55937 A.

HYDRAULICS.

Centrifugal Pumps.

Theory of Centrifugal Pumps and

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Fans. Analysis of their action with suggestions for designs. Elmo G. Harris. A study. Ill. 16500 w. Pro Am Soc of Civ Engrs—May, 1903. No. 55771 E.

Flow.

An Experimental Study of the Resistance of the Flow of Water in Pipes. Augustus V. Saph, and Ernest W. Schoder. Presentation and discussion of experimented facts, describing apparatus used, and methods. Tables, plates, &c. 1300 w. Pro Am Soc of Civ Engrs—May, 1903. No. 55770 E.

Hydrodynamics.

The Motions of Fluids Inside Solids of Revolution (Ueber Flüssigkeitsbewegungen in Rotationshohlräumen). Prof. F. Prásil. A mathematical discussion, using cylindrical coordinates, of the motions of fluids inside spaces bounded by surfaces of revolutions, with practical references to the design of turbines. Serial. Part 1. 2000 w. Schweiz Bauzeitung—May 9, 1903. No. 56043 D.

Pumping Plant.

See Civil Engineering, Water Supply.

Resistances.

Some Hydraulic Resistances. John C. Trautwine, 3d. An account of experiments to determine the resistance that water meters offer to the flow of water through them. Ill. 2000 w. Trans Assn of Civ Engrs of Cornell Univ—1903. No. 55927 F.

Slide Rule.

Hydraulic Diagrams and Further Notes Upon the Hazen-Williams Slide Rule. Leonard Metcalf. Gives diagrams and tables showing the relations existing between the new formula and the Chezy formula. 1500 w. Eng Rec—June 20, 1903. No. 55975.

Turbine Flow.

Turbine Flow Recorder. C. M. Allen. An illustrated explanation of a device which automatically records the quantity of water discharged from a turbine with variable gate openings and under variable heads. 1500 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55892.

Water-Wheels.

Tests with a Pelton Wheel. William Campbell Houston. Read before the Inst of Engrs & Shipbuilders in Scotland. An account of a long series of tests of a Pelton wheel working with a pressure of water from 200 lbs to 1000 lbs. per square inch, with an analysis of the results. The objects were to get the power and useful efficiency of the wheel, and to analyze how the water energy was spent. 800 w. Mech Engr—May 30, 1903. Serial. First part. No. 55665 A.

MACHINE WORKS AND FOUNDRIES.

Acceleration.

The Acceleration of Quick Return Mechanisms. W. V. Dunkin. A general discussion of a device much used to produce the slow advance and quick return motion in shaping machines, and the principles involved. 2500 w. Technograph—1902-3. No. 55737 D.

Boring.

Boring a Cylinder—A Shaper Used as a Milling Machine. An illustrated description of an ingenious modification of shop tools to arrange for work of a different character from that for which they were intended. 1000 w. Am Mach—June 25, 1903. No. 56140.

Boring Mill.

Description of Sixty-Foot Vertical Boring and Turning Mill Designed by John Riddell for General Electric Co. John Riddell. Ill. 2300 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55884.

Brass Castings.

A New and Sanitary Process of Pouring Brass in Casting. Illustrates and describes the apparatus devised by W. Lynes, which has proved successful in protecting the workmen from the noxious fumes and also saves a valuable by-product. 1000 w. Sic Am—June 13, 1903. No. 55852.

Methods of Gating and Molding Brass Castings. C. Vickers. Illustrates and describes methods that have given good results. 1600 w. Am Mach—June 25, 1903. No. 56143.

Brass Working.

The Working of Brass and Similar Alloys in the Hot State, and the Dick Squirting Process (Die Verarbeitung des Messings und Verwandter Legierungen auf Warmem Wege und das Warmpressverfahren von Alexander Dick). A. Hilpert. An illustrated paper on the working of brass, high in zinc and brass alloys while hot, and a description of the Dick process for squirting hot metal through dies. 2500 w. Zeitschr d Ver Deutscher Ing—June 6, 1903. No. 56080 D.

Castings.

An Australian Statue. John F. Buchanan. Gives an illustration of the design and explains the process of casting in detail. 1700 w. Foundry—June, 1903. No. 55761.

Change Gears.

The Evolution of the Change Gear. Oscar E. Perrigo. A study of the United States patents on the lathe change gear devices. Deals solely with devices designed for screw cutting. Ill. 6200 w. Mach, N Y—June, 1903. Serial. First part. No. 55615 C.

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Dies.

Dies for Sheet Metal Bag Clasps. Joseph V. Woodworth. Illustrates and describes the use of these dies. 1000 w. Am Mach—June 11, 1903. No. 55825.

A Triple-Action Die for Blanking, Drawing and Embossing an Aluminum Shell in One Operation. Joseph V. Woodworth. Illustrated description. 1000 w. Am Mach—June 18, 1903. No. 55958.

Discussions.

Topical Discussions and Notes of Experience. Includes a short description of a milling machine attachment for cutting worms; the adoption of a standard form of boiler for testing the calorific value of fuels is suggested, and a new form of flexible metallic tubing is described. Ill. 1500 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55909.

Expert Service.

The Metallurgical Engineer in the Foundry. Henry Sonther. Showing that there is wisdom and economy in employing a good metallurgical engineer. 2500 w. Jour Am Found Assn—June, 1903. No. 55751.

Fitting.

Fits and Fitting. Stanley H. Moore. An investigation of recent practice in forcing shrinking, driving and running fits, and limits for limit gauges. 3000 w. Trans Amer Soc of Mech Engrs—June, 1903. No. 55890.

Foundry Iron.

Blast Furnace Conditions Affecting the Chemical Composition of Foundry Iron. W. Walley Davis. Defines some of the blast furnace conditions that contribute to, or cause changes in the chemical composition of iron. 2800 w. Jour Am Found Assn—June, 1903. No. 55752.

Foundry Management.

Foundry Management. Edward Kirk. Describes conditions representing the management of fully half the foundries, and discusses improvements. 5200 w. Foundry—June, 1903. No. 55762.

Foundry Operation.

The Continuous Operation of the Iron Foundry. John C. Knoeppel. Views from the standpoint of a practical molder and foundryman, discussing features that should be considered. 1600 w. Jour Am Found Assn—June, 1903. No. 55756.

Gauge.

A Worm and Spiral Gear Tooth Gauge. Ernest J. Lees. Illustrates and describes the use of this thread tool gauge. 600 w. Am Mach—June 18, 1903. No. 55960.

High-Speed Steel.

See Mechanical Engineering, Materials of Construction.

Iron Mixtures.

A Simple Device for Ascertaining the Average Silicon in an iron mixture. Arthur W. Walker. Illustration and brief explanation of the working of a device consisting of a balanced scale. 400 w. Jour Am Found Assn—June, 1903. No. 55746.

Jig Work.

Accuracy in Jig and Fixture Work. J. M. Stabel. Illustrates and discusses a special indicator designed by the writer, for setting the buttons in perfect alignment with the milling machine spindle, and its use. 1000 w. Am Mach—June 4, 1903. No. 55639.

Lathes.

Some Lathe Shop Notes. Describes the methods of testing these machines as used by the F. E. Reed Co., of Worcester. Ill. 2000 w. Am Mach—June 4, 1903. No. 55637.

The Inefficiency of the Ordinary Lathe for High Speed Cutting. H. M. Norris. Read before the Cincinnati Metal Trades Assn. Discussion with an account of tests made on a new high speed lathe. Ill. 3000 w. Ir Age—June 11, 1903. No. 55720.

Milling Machine.

Milling Machine Methods. Illustrations with descriptions of operations in ordinary, every-day work. Gives also particulars of the material used, and other details of interest. 1400 w. Engr, Lond—May 22, 1903. No. 55544 A.

Molding.

Permanent Molds. James A. Murphy. Remarks on loam molding, with suggestions and illustrations. 800 w. Jour Am Found Assn—June, 1903. No. 55749.

Molding Machines.

The Molding Machine. S. H. Stupakoff. An illustrated discussion of these machines and what they are designed to accomplish. 4000 w. Jour Am Found Assn—June, 1903. No. 55754.

Molding Machines. Edward B. Gilmour. Remarks on the advantages and disadvantages of these machines, with an illustrated description of a stripping plate drop pattern machine and the castings made with it. 900 w. Jour Am Found Assn—June, 1903. No. 55747.

Pig-Iron Casting.

See Mining and Metallurgy, Iron and Steel.

Rail Re-Rolling.

The Renewal of Worn Steel Rails. N. L. Hurd. Describes fully the McKenna process of re-rolling worn steel rails. 1600 w. Wisconsin Engr—May, 1903. No. 56-125 D.

We supply copies of these articles. See page 797.

Screw Threads.

Measuring External Screw Thread Diameters. Walter Cantelo. Gives sketches, formulas and tables, worked out by the writer, so that by using ordinary micrometer calipers and wire of the diameter called for in the table, the standard threads can be compared with the figures given. 1200 w. Am Mach—June 25, 1903. No. 56142.

Sheet Iron.

The Manufacture of Sheet-Iron used in Dynamo Construction (Die Herstellung der im Dynamobau Gebrauchten Bleche). K. Frucht. An illustrated description of the machinery for cutting, stamping, slotting and performing other operations on iron sheets for armature cores and other purposes in dynamo construction. 3000 w. Zeitschr d Ver Deutscher Ing—May 30, 1903. No. 56077 D.

Sheet Metal.

A Punching and Curling Job. Joseph V. Woodworth. Illustrated description of methods of producing sheet metal parts of unusual shape. 1100 w. Am Mach—June 4, 1903. No. 55640.

Shop Construction.

New Shops of the American Turret Lathe Mfg. Co. Illustrates and describes the interesting features in shop construction. 1500 w. Mach, N Y—June, 1903. No. 55616 C.

The Machine Shop and Foundry of the Pencoyd Iron Works. Begins an illustrated description of these works, remarkable for their great strength—the construction is a steel frame with curtain walls of concrete filled in between the columns——also for the crane arrangements. 1200 w. Ill. Am Mach—June 25, 1903. Serial. 1st part. No. 56139.

Shop Equipment.

The Equipment of Machine Shops. Joseph Horner. Considers questions that have to be settled in the purchase of machinery and plant. Ill. 4500 w. Cassier's Mag—June, 1903. No. 55919 B.

The Shops of the E. W. Bliss Company, Brooklyn, New York. Joseph V. Woodworth. An illustrated detailed description of a large and finely equipped machine manufacturing plant. 4000 w. Ir Trd Rev—June 4, 1903. No. 55625.

See also Railway Engineering, Permanent Way and Buildings.

Springs.

Springs and Their Use. Ivar Kirkegaard. Remarks on the extensive use of springs, and discusses the use and manufacture of furniture springs, spiral springs, hot wound springs, jig springs, and flat wire springs. Ill. 5500 w. Ir Age—June 4, 1903. No. 55597.

MATERIALS OF CONSTRUCTION.

Alloys.

Influence of Casting Temperature on Properties of Alloys. Percy Longmuir. Abstract of a paper read before the Ir. and St. Inst. An account of researches with industrial brasses, describing methods and considering results. 2500 w. Mech Engr—May 30, 1903. No. 55662 A.

Alluminum Alloys.

Some Aluminum Alloys and Their Uses. Walter J. May. Directions for the making of aluminum alloys with strengths equal to cast iron or steel, and at a cost no more expensive than brass. 600 w. Prac Engr—June 5, 1903. No. 55725 A.

Decay of Metals.

The Decay of Metals. J. T. Milton. Abstract of a paper read before the Inst. of Civ. Engrs. Gives examples of the decay referred to, considering the causes. 1700 w. Elec Engr, Lond—May 22, 1903. No. 55536 A.

Emery Wheels.

The Bursting of Emery Wheels. Charles H. Benjamin. Gives illustrations and tabulated results of a number of tests made on wheels of various makes, bought in the open market. 600 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55886.

High-Speed Steel.

The Capabilities of High Speed Steel. William Lodge. Read before the Cincinnati Metal Trds. Assn. Gives table showing results in actual practice, with remarks on use of this steel. 1300 w. Am Mach—June 11, 1903. No. 55824.

Malleable Iron.

Malleable Cast Iron. Dr. Richard Moldenke. On the properties, composition and structure, with directions for making malleable castings. 3200 w. Jour Am Found Assn—June, 1903. No. 55753.

Metallic Packings.

Metallic Packings.—Principles of Design Essential for Successful Development. Charles Longstreth. Discusses the purposes and requisites of a successful packing, importance of care in design, etc. 3800 w. Jour Am Soc of Nav Engrs—May, 1903. No. 55860 H.

Micro-Structure.

Notes on the Micro-Structure of Cast Iron. Percy Longmuir. Discusses features of profitable interest revealed by microscopic examination. Ill. 800 w. Jour Am Found Assn—June, 1903. No. 55748.

Petrol.

How to Solve the Petrol Problem. A lesson from France. Comments on the better quality of petrol sold in France,

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and explains it as due mainly to the competition of alcohol. 2200 w. Autocar—June 6, 1903. No. 55777 A.

Piston Strength.

See Mechanical Engineering, Steam Engineering.

Strains.

Strains Produced by Excessive Tightening of Nuts. A. Bement. Calls attention to the fact that materials are frequently unduly strained during the process of assembling, by the excessive tightening of nuts, giving an example. 300 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55903.

Tool Wood.

Machine Tool and General Tool Woods of the Philippines. Describes tough woods adaptable for service in machine and general lines of modern tools. Ill. 1200 w. Mod Mach—June, 1903. No. 55689.

MEASUREMENT.

Anglemeter.

An Indicating Anglemeter. C. E. Sargent. Illustrated description of a device designed to determine at sight the maximum variation in engine flywheels. Its chief use is in running alternators in parallel. 1000 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55896.

Connecting Rods.

Investigation of the Stresses in a Connecting Rod, Due to the Inertia Forces. J. H. Wallace. Describes the investigation of such stresses in a particular case. Ill. 1200 w. Technograph—1902-3. No. 55741 D.

Dynamometer.

A New Apparatus for Determining the Resistance of Road Vehicles to Traction. Illustrates and describes the new dynamometer devised by Prof. Hele-Shaw for experimental investigation concerning the resistance of road vehicles to traction. 1700 w. Sci Am—June 6, 1903. No. 55654.

Fan Testing.

A Dynamometer and Revolution Counter for Fan Testing. D. W. Taylor. Illustrated description of an instrument designed and built for the purpose of making experimental investigation of the capacity and efficiency of ventilating fans which has been found quite satisfactory. 2000 w. Am Mach—June 11, 1903. No. 55823.

Hoisting Hooks.

Some Data on Hoisting Hooks. John L. Bacon. Gives results of some tests made on the strength of hooks bent out of round stock, and compares them with tests on those shaped according to Towne's Formula, giving also the effect of case hardening. Ill. 700 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55904.

Levels.

Hydrostatics and Spirit Levels. R. P. King. On methods of testing levels and using them, determining the probable error, etc. Ill. 1000 w. Am Mach—June 25, 1903. No. 56141.

Oils.

Simple Methods of Testing Oils. J. K. Nye. Considers methods of determining the viscosity, gravity, and fire test. 2000 w. Marine Engng—June, 1903. No. 55609 C.

A Comparative Oil Test. William F. Parish, Jr. Describes tests made for showing the relative efficiency of two different grades of oil made for the same kind of service. 1400 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55906.

Plates.

Comparative Tests of Plain and Riveted Plates. E. J. McCaustland. Results of tests made to determine the relation existing between plates and shapes of structural steel, and the same properties of plates and shapes used collectively in built-up members. 1500 w. Trans Assn of Civ Engrs of Cornell Univ—1903. No. 55925 F.

Wire Rope.

The Strain in the Core Wire of Strands (Die Beanspruchung der Litzen-Seelendrähte). Julius Divis. An account of experiments on the strength of wire ropes, with particular reference to the part played by the center or core wire. Diagrams. Serial. 2 Parts. 4000 w. Oesterr Zeitschr f Berg u Hüttenwesen—May 30, June 6, 1903. No. 56036 D.

POWER AND TRANSMISSION.

Accidents.

Accidents Due to Combustion Within Air Compressors. Editorial discussion of points to be considered to avoid accidents. Called out by Dr. Ledoux's paper before the Am. Inst. of Min. Engrs. 600 w. Compressed Air—June, 1903. No. 56118.

Air Compressors.

Compressed Air for Pumps. Frank Richards. Some remarks on means of determining the sizes of air compressors for operating pumps. 600 w. Am Mach—June 4, 1903. No. 55638.

Flywheels.

Flywheels, Their Purpose, Principle and Design—Calculation for Speed Variation. William Burlingham. Gives an idea of some of the difficulties in the work, and the reasons for the adoption of the varying types. Ill. 3000 w. Mach, N. Y.—June, 1903. No. 55617 C.

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Elevators.

Tests of an Hydraulic Elevator System. Reginald Pelham Bolton. Describes the trial of an elevator system installed in a new department store in New York. 1800 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55889.

Hoisting.

Tests of the Efficiency of Hoisting Tackle. S. L. Wonson. An account of tests recently carried out by the American Bridge Co. of New York, using its standard types of blocks, with various combinations of manila and wire rope. Tabulated results are given. 800 w. Eng News—June 11, 1903. No. 55832.

Ore Handling.

Gigantic Ore-Handling Machinery. W. Frank McClure. An account of important innovations in connection with the ore-handling industry, with illustrations of ore-unloaders. 1200 w. Sci Am—June 20, 1903. No. 56109.

Rubber Belting.

Hints on Rubber Belting. W. H. Kritzer. Suggestions for the selection, care, and running of these belts. 700 w. Min & Sci Pr—May 30, 1903. No. 55701.

SPECIAL MOTORS.

Alcohol Motors.

French Research on Alcohol Motors. Capt. C. C. Longridge. Indicates the line of reasoning in the report of M. Sorel in regard to certain points. Considers the fuel employed, effects of the fuel on the motor, analysis of the exhaust gases, quantity of air required for combustion, and carburation. 1700 w. Engr, Lond —June 5, 1903. No. 55802 A.

Binary Engine.

Sulphur-Dioxide and the Binary Engine. R. H. Thurston. A study of the physical properties of sulphur-dioxide and the economical advance claimed for the series-vapor engine of Prof. Josse. 2700 w. Jour Fr Inst—June, 1903. No. 55736 D.

Blowing Engines.

Blast-Furnace Gas Engines and Steam Engines. H. G. Scott. Facts given in connection with the discussion of a paper by Cecil A. Cochrane, at a meeting of the Cleveland Inst. of Engrs. Compares the efficiency. 3000 w. Engng—May 22, 1903. No. 55542 A.

Gas-Driven Blowing Engine (Delamere-Debouttevilleé & Cockerill System). Illustrated description of 750 h. p. blowing engines driven by blast-furnace gas, and of the working. 1800 w. Engng—May 22, 1903. No. 55540 A.

Gas Engines.

Current Practice in Gas Engine Design. H. Lee Koenig and G. W. Rice. Investigations based on data of some eighty engines. 3800 w. Sib Jour of Engng—June, 1903. No. 55758 C.

The Nuremberg Double-Acting Tandem Gas Engines. Reviews the different methods adopted by the various makers to obtain great mechanical power from one single engine, and gives drawings showing the construction of the new type of engine named. 2400 w. Ir & Coal Trds Rev—June 12, 1903. No. 55942 A.

Gas-Engine Tests.

A Method of Testing Gas Engines. E. C. Oliver. An illustrated paper describing methods and apparatus in use in some tests on a 10 h. p. Otto gas-engine to determine the distribution of the heat supply by the fuel, and the temperature at various points in the cycle, giving the results of the heat tests. 3500 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55899.

Tests of a Twelve-Horse-Power Gas Engine to Determine the Effects of Changes in Speed, Load, Point of Ignition, Ratio of Gas to Air, and Jacket Temperature. C. H. Robertson. A record of tests at Purdue Univ. continuing over a period of six years. Full description, with conclusions. Ill. 6500 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55885 C.

Kerosene Engine.

Performance of an Internal Combustion Engine Using Kerosene and Gasoline as Fuel. H. F. Halladay and G. O. Hodge. Reports a series of investigations made to determine the economic performance of a standard engine of the Otto type. 5200 w. Trans Am Soc of Mech Engrs —June, 1903. No. 55897 D.

Oil Engine.

The Ostergren Fuel Oil Engine. Illustrates a 50-h. p. stationary engine, explaining its operation, and stating the general merits of the invention. 1200 w. Sci Am —June 6, 1903. No. 55651.

Petrol Engines.

The Blake Petrol Engines. An illustrated description of an engine of 40 to 50 nominal h. p., designed with a view to rendering it suitable for a variety of purposes. 2500 w. Auto Jour—June 6, 1903. No. 55779 A.

STEAM ENGINEERING.

Balancing Engines.

See Marine and Naval Engineering.

Boilers.

Boiler and Furnace Efficiencies. A. Bement. Read before the Nat. Elec. Lgt. Assn. Discussing some features of the performance of modern standard apparatus, considering two types of boilers,

two furnaces, and one stoker. 5000 w. Elec Rev, N. Y.—June 13, 1903. No. 55828.

The Naval Boiler Question in France. Discussing the relative merits of large and small size tubes for boilers of cruisers and battleships. An official order of the French Minister of Marine. 3000 w. Jour Am Soc of Nav Engrs—May, 1903. No. 55862 H.

A New Type of Water-Tube Boiler. Translation from an article on the "Water-Tube Boilers for Merchant Ships," by Constructing-Engineer Benetsch. An illustrated description of the Schüette combined Scotch and water-tube boiler. It is of the oval fire-tube type, with small-tube water-tubes behind the combustion chamber. 1800 w. Marine Engng—June, 1903. No. 55607 C.

The Moore Vertical Water-Tube Boiler. States the considerations that led to the design of boiler and boiler furnace patented by Enos L. Moore, giving an illustrated description. 1600 w. Ir Age—June 25, 1903. No. 56138.

The Experiment Boiler of the Ohio State University, with Results of Some Trials. E. A. Hitchcock. Outlines the details and installation of an experimental boiler with its accessories, and gives results of various trial running. Ill. 9000 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55907 D.

Boiler Tubes.

Seamless Steel Boiler Tubes.—Their Limited Endurance a Menace to Naval Efficiency. Lieut. Newton Mansfield. Discusses the endurance of iron and mild-steel tubes, nickel steel tubes and cold-drawn steel tubes, etc. Ill. 5000 w. Jour Am Soc of Nav Engrs—May, 1903. No. 55861 H.

Compound-Engine Test.

Water and Heat Consumption of a Compound Engine at Various Powers. D. S. Jacobus. Describes test of the Rice & Sargent horizontal cross-compound type, provided with a Corliss valve gear. Gives method of testing, conditions, and results. 1400 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55905.

Condensers.

The Condensing Plant of the New York Rapid Transit Power House. An illustrated detailed description of this interesting plant. 1800 w. Power—June, 1903. No. 55558 C.

The Self-Cooling Condenser. Thomas L. Wilkinson. A contribution to steam economics. 1200 w. Min Rept—May 28, 1903. Serial. 1st part. No. 55550.

Distilling Apparatus.

The Goss Series Distilling Apparatus. Charles Ducas. An illustrated description of an apparatus by which it is practicable to obtain between 70 and 80 lbs. of water per lb. of coal burned. 2800 w. R R Gaz—June 19, 1903. No. 55977.

Feed Water.

The Purification of Feed Water. J. B. Greer. Reviews the development of water purification in the United States. General discussion. 8000 w. Ry Club of Pittsburgh—Feb., 1903. No. 55806 C.

Fuel.

Fuel: What We Don't Know About It. Edward Atkinson. A discussion of the use of peat, turf, briquettes from culm, and various kinds of fuel other than coal, with information relating to their formation. General discusion follows. 8400 w. Jour N E Water Wks Assn—June, 1903. No. 55956 F.

Governor Drives.

Positive Governor Drives for Corliss Engines. A. H. Eldredge. A brief illustrated article strongly advocating the use of gearing or sprocket and chain to replace belts for governor drive. 600 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55891.

Jacketing.

Performance of an Engine Designed for Maximum Jacketing Effects. W. F. M. Goss. Describes a new design made to secure an arrangement by means of which the cylinder walls can at all times be maintained at a temperature closely approaching that of the initial steam. Reports tests. Ill. 1500 w. R R Gaz—June 19, 1903. No. 55981.

Liquid Fuel.

Liquid Fuel for Power Purposes. Arthur L. Williston. A discussion of the economic side of the question, showing when and where it will pay to substitute oil for coal; gives also a clear summary of the present and possible future output of fuel oil. Illustrated by charts. 4500 w. The Engineering Magazine—July, 1903. No. 56174 B.

Marine Engines.

See Marine and Naval Engineering.

Oil Extractor.

The Hot Well as an Oil Extractor. A. H. Eldredge. A brief illustrated description of the details and action of the hot-well and its use for the separation of oil from the water from the cylinder which passes through it. 4500 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55888.

Piston Strength.

The Strength of Pistons of Steam Engines (Conditions de Résistance des Pistons des Machines à Vapeur). M. Codron. An extensive mathematical discussion of the different stresses and strains in

pistons of steam engines. Diagrams. Serial. Part 1. 7500 w. Rev de Mécanique—May 31, 1903. No. 56166 E + F.

Progress.

Recent Progress in Steam Engines (Quelques Progrès Récemment Réalisés dans les Machines à Vapeur). P. Arrachart. A general review, with particular reference to the Paris and Düsseldorf Expositions, and illustrated descriptions of improvements and new features in steam engines and of steam turbines. 1 Plate. 8000 w. Mem Soc Ing Civils de France —April, 1903. No. 56160 G.

Pumping Engines.

The Heisler Compensating Gear for Direct-Acting Pumping Engines. Notes briefly the methods of compensating used in various pumps, and gives an illustrated detailed description of the method devised by Chas. L. Heisler. It comprises essentially a link connection between the two piston rods of a duplex or a compound pump. 3800 w. Eng News—June 4, 1903. No. 55629.

See also Civil Engineering, Water Supply.

Reciprocating Engines.

A Study of the Mechanical Operation of Reciprocating Engines (Contribution à l'Etude du Fonctionnement Mécanique des Machines Alternatives). R. Lelong. A mathematical and graphical discussion of the laws underlying the operation of reciprocating engines, with a view to indicating the directions for improvements. Diagrams. Serial. Part 1. 8000 w. Rev de Mécanique—May 31, 1903. No. 56165 E + F.

Steam.

The Expansion, Separation, and Compression of Wet Steam. Robert H. Smith. A study in thermo-dynamics suggested by the paper read by Prof. W. H. Watkinson in Glasgow, on Feb. 17, 1903. 3500 w. Engr, Lond—May 29, 1903. No. 55681 A.

Steam Engines.

Corliss Engines. George C. Phillips. A full illustrated account of this great invention, with descriptions of the types made by the numerous manufacturers, and much information of interest. 3700 w. Engr, U S A—June 15, 1903. No. 55961 C.

High-Speed Engines. Charles T. Porter. Discusses the development and probable future changes of these engines, and gives illustrated descriptions of many types, and of matters relating to their operation. 30000 w. Engr, U S A—June 15, 1903. No. 55963 C.

Low and Medium-Speed Engines. J. W. Thompson. An illustrated detailed description of slow and medium rotative speeds; the characteristics of the various styles; their adjustment, etc. 1700 w. Engr, U S A—June 15, 1903. No. 55962 C.

Continental Engine Construction. Two articles presenting some of the leading features of heavy stationary engine construction for electric traction, lighting, and power transmission. 4500 w. Engr, Lond —May 29 and June 5, 1903. Serial. 2 parts. No. 55680 each A.

Lentz Steam Engines for Driving Electric Generators (Ueber Dampfmaschinen für Elektrische Betriebe, Bauart Lentz). Fr. Freytag. A paper before the Elektrotechnischer Verein, giving an illustrated description of the Lentz steam engines and their piston-valve gear, particularly adapted to the driving of electric generators. 3000 w. Elektrotech Zeitschr—June 11, 1903. No. 56098 B.

Steam Heating.

The Thermograde System of Steam Heating. Walter E. Barnes. An illustrated description of this system which claims to have overcome some of the disadvantages of other systems, and to have advantages of its own. 2400 w. Harvard Engng Jour—May, 1903. No. 55732 D.

Steam Turbines.

The Steam Turbine from an Operating Standpoint. Frederick A. Waldron. Description and test of a 400 k. w. turbo-generator at the Yale & Towne Works. Treats the subject not only from the operating standpoint, but includes data from the boiler room to the motor pulley. Ill. 4500 w. Trans Am Soc of Mech Engrs —June, 1903. No. 55895 C.

Testing Methods of the Westinghouse Machine Co. for Steam Turbines. Edwin Yawger. Read before the Cleveland Elec. Club. Explains the careful methods of this company, the systematic testing, and related matters. Ill. General discussion. 6500 w. Engr, U S A—June 1, 1903. No. 55636 C.

Exhaust-Steam Turbines. Editorial review of the investigations of Prof. A. Rateau and his recently developed system, giving an illustrated description of a plant in working at the Bruay coal mines (Pas-de-Calais). 2200 w. Engng—June 5, 1903. No. 55791 A.

Stokers.

Mechanical Stokers. Edwin Fitts. Explains the combination of fuel in a furnace, different forms of furnaces, outlines the history of mechanical stoking, giving illustrations of various types. 3300 w. Pro Engrs' Soc of W Penn—April, 1903. No. 55768 D.

Superheating.

The Question of Superheated Steam in Locomotives (Zur Frage der Anwen-

dung der Dampfüberhitzung im Lokomotivbetriebe). Otto Berner. A systematical discussion of tests, by different investigators, on the use of superheated steam in locomotives. Tables and illustrations. Serial. 2 Parts. 10000 w. Zeitschr d Ver Deutscher Ing—May 23 and 30, 1903. No. 56074 each D.

Superheated Steam in Locomotive Service. The first of a series of articles presenting an elementary view of the problem, to be followed by a discussion of the development of the practice in America and Europe, with special attention to the Schmidt system. 2000 w. R R Gaz—June 5, 1903. Serial. 1st part. No. 55660

Test of Superheated Steam. Prof. M. Schröter. A report of trials made at Ghent, on a horizontal tandem engine, driving a continuous current dynamo, to examine the economy at different degrees of cut-off and at different temperatures of superheating. 2700 w. Power—June, 1903. No. 55559 C.

Thermodynamics.

Graphics of Thermodynamics: A Comparative Study. J. L. Bates and E. C. Welborn. The cycles of the Carnot, the Otto, the Brayton, the Ericsson and the Sterling have been computed, and under such assumptions that when plotted the resulting cycles would superimpose and give to the eye a suggestion of relative characteristics. 1200 w. Sib Jour of Engng—June, 1903. No. 55759 C.

MISCELLANY.

Acetylene Blowpipe.

The Working of Metals With the Oxygen-Acetylene Blowpipe (La Soudure Autogène des Métaux. Soudure au Chalumeau Oxyacétylénique). André Binet. An illustrated description of a blowpipe using acetylene and oxygen for conveniently producing very high temperatures, and its applications in metal working. 2000 w. Génie Civil—May 23, 1903. No. 56153 D.

Aeronautics.

The Problem of Aerial Navigation (Ueber die Versuche zur Lösung des Problemes der Luftschiffahrt). Ferd. Gerstner. Paper discussing the problems of aerial navigation and the different classes of air ships and balloons. Diagrams and tables. 5000 w. Zeitschr d Oesterr Ing u Arch Vereines—April 10, 1903. No. 56012 B.

The Tetrahedral Principle in Kite Structure. Alexander Graham Bell. Reprinted from the *Nat. Geog. Mag.* An illustrated account of work in this field, especially showing the advantages of the tetrahedral principle. 4500 w. Sci Am Sup—June 13, 1903. No. 55856.

The Kite Principle in Aerial Navigation. Garrett P. Serviss, Jr. A discussion of the mechanical principles involved as shown by kites, and their application to aerial navigation. 1600 w. Sci Am—June 27, 1903. No. 56148.

Experiments Preliminary to Crossing the Sahara Desert by Balloon (Récents Sondages de l'Atmosphère pour la Traversée du Sahara en Ballon). M. Dibos. Observations on the winds of the Sahara, and description of trial balloons and the flight of one from Gabes, in Tunis, to a point in Algeria, 600 kilometers distant. 4000 w. Mem Soc Ing Civils de France—April, 1903. No. 56159 G.

Agricultural Machinery.

Agricultural Engineering. An extended illustrated description of British agricultural machinery for the colonies. Illustrates and describes in detail the various implements. 13500 w. Engr, Lond—June 12, 1903. (Supplement.) No. 55946 A.

Agricultural Machinery in New Zealand. An account of the progress in the use and also in the manufacture of agricultural machinery. 1800 w. Engr, Lond—June 12, 1903. No. 55944 A.

Construction Machinery.

Construction Machinery at the Düsseldorf Exposition, 1902 (Die Baumaschinen der Düsseldorfer Ausstellung, 1902). W. Hübbe. An illustrated account of concrete mixers, elevators, pile drivers, excavators and other machines for building operations. 3000 w. Zeitschr d Oesterr Ing u Arch Vereines—May 8, 1903. No. 56020 B.

Drawing Rooms.

Drawing Office Equipment. John McGeorge. Discusses light, natural and artificial, space allotted to each man, types of drafting boards, sanitary arrangements, blue-print facilities, etc. 3000 w. Ill. Trans Am Soc of Mech Engrs—June, 1903. No. 55902.

Düsseldorf Exposition.

A Brief Account of the Düsseldorf Exposition (Kurze Mitteilungen von der Düsseldorfer Ausstellung). Berthold Braun. An address, giving an account of some of the mechanical features of the Düsseldorf Exposition of 1902, with illustrations. 4000 w. Zeitschr d Oesterr Ing u Arch Ver—May 1, 1903. No. 56017 B.

Gear Drafting.

An Instrument for Drawing the Teeth of Gear Wheels (Zahnkurven-Zeichenmaschine). Franz Haas. An illustrated description of a convenient instrument, like a beam compass, for drawing teeth which have practically correct forms. 2500 w. Zeitschr d Ver Deutscher Ing—May 16, 1903. No. 56073 D.

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Heating.

European Heating Apparatus. Charles F. Hauss. Brief illustrated descriptions of systems in use. 3800 w. Met Work—June 13, 1903. No. 55810.

Test of a Direct-Connected 8-Foot Fan and Engine. E. S. Farwell. Describes a test made to obtain reliable data which would serve as a guide in the selection of size of apparatus for a given case of heating. The methods of conducting the test are outlined and the details discussed. Ill. 3000 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55900.

See also Mechanical Engineering, Steam Engineering.

Hydroscope.

Pino's Hydroscope and the Efforts of His Predecessors. Dr. Carlo Iberti. The present article describes an English and an American instrument of like style to Pino's hydroscope, which will be described in later numbers. Ill. 1200 w. Elec Engr, Lond—May 29, 1903. Serial 1st part. No. 55677 A.

Laundry Machinery.

Some Present Requirements in Laundry Machinery. Henry Waring. A systematic study of the requirements of a large steam laundry. 4000 w. Engng—May 29, 1903. No. 55685 A.

Liquid Air.

Practical Liquid Air Possibilities. Dr. Carl von Linde. Extracts from an address before the Ice and Cold Storage Assn., of London, considering its use for refrigeration and power. 3200 w. Cassier's Mag—June, 1903. No. 55918 B.

Lubrication.

Friction on Lubricated Surfaces. F. A. McKay. Prize essay. Studies the effect of pressure, velocity, and temperature on friction; also lubricants and methods of testing them. 3800 w. Can Engr—June, 1903. No. 55695.

The Zöller Lubrication System (Zöller's Zentral-Schmiervorrichtung). W. K. Macka. An illustrated description of a system of lubrication in which the oil is in holes bored through the centers of shafts and journals and is conducted to the bearings by centrifugal action. 1 Plate. 1600 w. Oesterr Zeitschr f Berg u Hüttenwesen—May 9, 1903. No. 56032 D.

Oiling System. P. E. Moock. Discusses the essentials of a successful oiling system, and gives information in regard to an inexpensive system recommended. 1500 w. Power—June, 1903. No. 55560 C.

See also Mechanical Engineering, Measurement.

Mechanical Plant.

Mechanical Plant of the Farmers' Deposit National Bank Building, at Pittsburg. Describes this fine 24-story office building, and the plants for lighting and for furnishing power for the elevators. Ill. 5500 w. Engr, U S A—June 1, 1903. No. 55635 C.

Plumbing.

House Drainage. A. B. Raymond. From a paper read before the Mich. Engng. Soc. Shows where the danger lies in present practice and the forms of construction employed to prevent danger. 2200 w. Dom Engng—June 25, 1903. No. 56368.

Problems.

Some Unsolved Problems in Engineering. W. H. Maw. Abstract of the eleventh "James Forrest" lecture at the Inst. of Civ. Engrs. Devoted principally to heat engines, and to strength of materials, and showing the desirability of engineers and physicists working together in investigations of engineering problems. 4800 w. Elect'n, Lond—June 19, 1903. No. 56339 A.

Refrigeration.

Mechanical Refrigeration. Otto Luhr. Explains process and gives formulas for capacity, efficiency, etc. 3500 w. Ice & Refrig—June, 1903. No. 55604 C.

Smoke Prevention.

Burning Illinois Coal without Smoke. L. P. Breckenridge. From a paper read before the Commercial Club of Chicago. Discusses the lines to be followed in the construction of new plants for burning bituminous coals, and what can be done to improve existing plants. 2000 w. Eng News—June 11, 1903. No. 55831.

Speed Indicator.

The Karlik Tachygraph for Winding Engines. H. Hubert, in *Revue Universelle des Mines.* Illustrated description of a speed-indicator for colliery engines, which is extensively used in Austria. 500 w. Col Guard—June 5, 1903. No. 55788 A.

Watervliet Arsenal.

United States Army Gun Factory, Watervliet Arsenal, N. Y. John M. B. Scheele. General description, with a brief account of the shops, calling attention to interesting details. 1200 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55887.

Wire Guns.

Wire-Bound Ordnance. Charles Berthon. Illustrates and describes the details of construction of wire-wound guns, giving a brief review of the system. 3500 w. Feilden's Mag—June, 1903. No. 55913 B.

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MINING AND METALLURGY

COAL AND COKE.

Analysis.

The Distinguishing Characteristics of Brown Coal and Hard Coal (Zur Unterscheidung von Braun- und Steinkohle). Ed. Donath and Hugo Ditz. A discussion of the chemical and physical difference of coals and methods of determining them. 3000 w. Oesterr Zeitschr f Berg u Hüttenwesen—June 6, 1903. No. 56-037 D.

British Trade.

The Growth and Direction of Our Foreign Trade in Coal During the Last Half Century. D. A. Thomas. Read before the Royal Statistical Soc. A study of the growth, character and direction of British trade in coal during the second half of the nineteenth century. 15000 w. Ir & Coal Trds Rev—May 22 and 29, 1903. Serial. 2 parts. No. 55547 each A.

Charcoal.

A New Charcoal Cooling Process. Bernard Zwillinger. A description of a process of cooling by the cold gases which are produced during the distillation of wood under exclusion of air, with the advantages claimed. 4300 w. Ir Age—June 11, 1903. No. 55721.

Coal Cutting.

Coal-Cutting by Machinery. Owen Hughes. Read before the Manchester Geol. & Min. Soc. A record of actual operations, under varying conditions, extending over a considerable period. 6800 w. Col Guard—June 12, 1903. No. 55870 A.

On Coal-Cutting by Machinery. Owen Hughes. Read before the Manchester Geol. & Min. Soc. Describes the system adopted with the machines, the timbering, average results of working, cost, and related matter. 6800 w. Ir & Coal Trds Rev—June 5, 1903. No. 55805 A.

The Chain and the Pick Machines. H. S. Johnson. A comparison of the two types of coal-cutters from the standpoint of an advocate of chain machines. Ill. 1800 w. Mines & Min—June, 1903. No. 55571 C.

Coal Storage.

A Circular Storage System for 50,000 Tons of Coal. Illustrates and describes an interesting plant recently installed at the works of the Maryland Steel Co. for the handling and storage of soft coal. 800 w. Ir Age—June 4, 1903. No. 55596.

Coke.

Comparative Test of Beehive and Retort Coke. E. A. Uehling. A study of their relative merits as a blast-furnace fuel, giving the procedure and results of a test. 4800 w. Ir Age—June 11, 1903 No. 55723.

Retort Oven Coke for Foundry Use. W. J. Keep. Describes briefly the old fashioned bee-hive oven and the newer retort oven, and gives the writer's experience with retort oven coke. 1200 w. Jour Am Found Assn—June, 1903. No. 55750.

Coke Oven.

The Bauer Coke Oven. An illustrated description of an oven claiming a large yield of coke of good quality, and an economical utilization of the volatile constituents. 2500 w. Col Guard—June 12, 1903. No. 55869 A.

The Hennebutte System of Coke-Making. M. Warolus. Describes this system and reports its application at the Houssu Colliery. 900 w. Col Guard—May 29, 1903. No. 55679 A.

France.

Methods of Working Coal in the North of France. An account of methods, principally in inclined seams, as given in the report of the Prussian Royal Commission. Ill. 1200 w. Ir & Coal Trds Rev—May 22, 1903. No. 55548 A.

Haulage.

Compressed Air and Electricity for Haulage in Coal Mines. A commentary on W. B. Clarke's paper, read at meeting of the Am. Inst. of Min. Engrs. 2000 w. Mines and Min—June, 1903. No. 55572 C.

Peat.

See Mining and Metallurgy, Miscellany.

Pennsylvania.

Coal Production of Pennsylvania. Statistics from the reports for 1902, with remarks. 1000 w. Eng & Min Jour—June 6, 1903. No. 55715.

United States.

See Industrial Economy.

Washery.

The Bellevue Washery of the D. L. & W. R. R. Co., Scranton, Pa. George W. Harris. Illustrates and describes the methods and machinery employed in handling and separating coal from culm banks. 3500 w. Mines & Min—June, 1903. No. 55565 C.

COPPER.

Concentration.

A Point in Concentration. M. A. Knapp. Diagram, with explanation, of the effect of cutting out concentrates and

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middlings at seven different points, on a table which is handling low-grade copper ore carrying 3.1 per cent. of copper. 1700 w. Eng & Min Jour—June 20, 1903. No. 55996.

Cupro-Silicon.

Cupro-Silicon (Cuprosilicium [Siliciumkupfer]). Gustav Kroupa. An account of this combination of copper and silicon, which is now produced in the electric furnace, and of its uses. 1600 w. Oesterr Zeitschr f Berg u Hüttenwesen—May 23, 1903. No. 56035 D.

Extraction.

A Proposed Process for Extracting Copper from Low Grade Ores. G. D. Van Arsdale. Notes on some reactions in which sulphur-dioxide is used as a precipitant of copper from sulphate solutions, and as a means of producing sulphuric acid for leaching. 1000 w. Eng & Min Jour—June 6, 1903. No. 55711.

New Mexico.

The Copper Deposits of the Sierra Oscura. H. W. Turner. An account of some low-grade mines in New Mexico. 1500 w. Pacific C Min—May 23, 1903. No. 55600.

Treatment.

Treatment of Low Grade Copper Ores. Dr. Edward Dyer Peters. Read before the Inst. of Min. Engrs., England. Enumerates and briefly considers the methods of treating these ores, with suggestions. 1300 w. Min Rept—June 4, 1903. Serial. 1st part. No. 55693.

GOLD AND SILVER.

Alaska.

The Gold-Bearing Gravels of Alaska. John D. McGillivray. A brief summary of their position and extent, with suggestion of means for vastly increasing their accessibility by a logical and inexpensive policy of taxation and road building. Illustrated. 3800 w. The Engineering Magazine—July, 1903. No. 56169 B.

Aurite.

Aurite, and a General Theory of Gold Ore Genesis. Joseph Voyle. Describes this new alloy, or exude, which the writer believes to be the universal primary origin of all gold. 1200 w. Min & Sci Pr—June 13, 1903. No. 56102.

Australia.

Review of the Progress of Gold Mining in Australia During 1902. Donald Clark. Reports concerning Western Australia, Victoria, Queensland, New Zealand, Tasmania, New South Wales and South Australia. 3000 w. Eng & Min Jour—June 6, 1903. No. 55709.

California.

Gold Quartz Mining in Kern County. C. S. Long. An illustrated article giving information of the industry near Kernville, Cal. 1200 w. Pacific C Min—May 23, 1903. No. 55602.

How Nevada County Shows in Mining. J. O. Denny. An outline of its past career as an important gold-producing district. Ill. 4000 w. Pacific Coast Min—May 30, 1903. No. 56120.

New Plant of the Royal Consolidated Mines Co., Ltd., Hodson, Cal. Horace F. Brown. Illustrates and describes recent improvements consisting of a modern 120-stamp, wet-crushing gold mill, a new crushing and hoisting plant at the mines, and an electric tramway from mine to mill. 1500 w. Min & Sci Pr—May 23, 1903. No. 55562.

Cyanide Slimes.

The Extraction of Gold from Cyanide House Slimes by a Wet Method. John Fleming. Sketches a process tried by the writer, describing two experiments made, and discussing results. Ill. 5000 w. Jour Chem & Met Soc of S Africa—April, 1903. No. 55666 E.

Deposits.

Observations on Gold Deposits. Chester Wells Purington. The first of a series of three articles on the occurrence of gold ores in distant regions. 2300 w. Eng & Min Jour—June 6, 1903. Serial. 1st part. No. 55712.

Dumps.

The Sampling of Mine and Mill Dumps. A. W. Warwick. Illustrates by an example the tendency to overvalue these dumps in the present article. 800 w. Min Rept—June 11, 1903. Serial. 1st part. No. 55812.

Georgia.

Dahlonega District, Georgia. Edwin C. Eckel. Reprinted from *Contributions to Economic Geology*. A description of the location, and the geology of the gold and pyrite deposits as shown in some of the mines now working. 3300 w. Mines & Min—June, 1903. No. 55568 C.

Lower California.

Santa Catarina District in Baja California. Morris McCarthy. An illustrated account of promising copper, silver, and gold mines in Lower California. 3500 w. Pacific C Min—May 23, 1903. No. 55601.

Queensland.

Mount Hector. C. F. V. Jackson. Preliminary report on a recent discovery of gold and copper ores in Queensland. 2800 w. Queens Gov Min Jour—April 15, 1903. No. 55623 B.

Recent Mining Developments on the Ravenswood Goldfield. Walter E. Cameron. A geological survey report giving

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information of this district. Map. 5500 w. Queens Gov Min Jour—April 15, 1903. No. 55624 B.

Sampling.

Notes on Automatic Ore Sampling. Alfred Harvey. Principally a description of the working of the Vezin Sampler. Diagrams. 1400 w. Min & Sci Pr—June 6, 1903. No. 55818.

An Automatic Sampler for Tailings, Sands and Slimes. C. H. Pead. Illustrated description of a design by the writer which has given good results. 700 w. Jour Chem & Met Soc of S Africa—April, 1903. No. 55667 E.

Sorting.

Ore Sorting. A. W. Warwick. Calculations showing an increase in profit when the ore is sorted. 1200 w. Min Rept—June 4, 1903. No. 55692.

Tasmania.

Smelting at Mt. Lyell, Tasmania. Abstracted from the report of the Secretary for Mines, Tasmania. Description, with illustration of works. 3200 w. Eng & Min Jour—May 30, 1903. No. 55579.

Yukon.

Methods and Values on the Yukon. John D. McGillivray. An account of the improvements in methods and reduction in cost of working, with general information. Warns capitalists to consider the cost of transport before investing in this region. 2200 w. Eng & Min Jour—June 13, 1903. No. 55843.

IRON AND STEEL.

American Iron.

American Iron Trade Outlook. Editorial discussion of the pig-iron situation in America, and commenting on editorials in the *N. Y. Times* and the *Iron Age*. 1600 w. Engng—June 12, 1903. No. 55950 A.

Blast-Furnace Explosions.

Blast Furnace Explosions Due to the Hanging of the Charge (Ueber die Durch das Hängen der Gichten Veranlassten Hochofenexplosionen). Director Schilling. A paper before the Verein Deutscher Eisenhüttenleute on blast-furnace explosions and their causes, and upon the sticking of the charge, and the consequent abnormal reactions. Discussion. 3000 w. Stahl u Eisen—May 15, 1903. No. 56177 D.

Casting Machinery.

Pig-Iron Casting and Conveying Machinery. E. A. Uehling. An illustrated article reviewing its development in the United States. 7500 w. Cassier's Mag—June, 1903. No. 55917 B.

Electric Furnaces.

Electric Furnace Methods of Iron and Steel Production. John B. C. Kershaw. Gives details of electric furnaces designed for the production of iron and steel which have had actual trial, with diagrams where possible. 1800 w. Elec Rev, N. Y.—June 6, 1903. Serial. 1st part. No. 55702.

Furnace Obstructions.

The Menne Process for Removing Obstructions in Blast Furnaces and Elsewhere (Mitteilungen über ein Verfahren zum Beseitigen von Hochofenansätzen und Dergleichen). Dr. Menne. A paper before the Verein Deutscher Eisenhüttenleute, describing a process for removing metallic and other solidified obstructions in blast and other furnaces by melting them with their own heat of oxidation. Discussion. 1500 w. Stahl u Eisen—May 15, 1903. No. 56178 D.

Pig Iron.

Loss of Sulphur in Borings of Pig or Cast Iron. W. E. Dickson. An account of the writer's experience showing that borings of pig or cast iron lose very appreciable amounts of sulphur on standing. 600 w. Jour Am Found Assn—June, 1903. No. 55745.

See also Industrial Economy.

Steel Manufacture.

Eliminating Gases and Slags from Molten Steel. F. C. Weber. Remarks on the methods that have been devised for this purpose, and the work of the writer in this field. 900 w. Ir Trd Rev—May 28, 1903. No. 55554.

Steel Works.

Britannia Steel Works, Middlesbrough. Gives an introductory description of the chief incidents in the formation of this firm, with a detailed account of the reconstructed works and the appliances with which they are equipped. Ill. 4000 w. Engng—June 12, 1903. Serial. 1st part. No. 55947 A.

The Works of the Lackawanna Steel Company. The present article gives a general illustrated description of the different parts of the plant at Buffalo, and their purposes. 5500 w. Eng Rec—May 30, 1903. Serial. 1st part. No. 55582.

Structural Steel.

See Civil Engineering, Materials.

Sweden.

Iron Mining in Sweden (Ueber den Schwedischen Eisenerzbergbau). Arpád Zsigmondy. An illustrated article from *Bány és Koh. lapok*, giving a description of the iron ores and mines of Sweden. Serial. 2 Parts. 3 Plates. 6000 w. Oesterr Zeitschr f Berg u Hüttenwesen—May 23 and 30, 1903. No. 56034 each D.

United States.

See Industrial Economy.

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Vancouver.

Iron Ore Deposits of Vancouver and Texada Islands. W. M. Brewer. Describes these deposits, giving theories relative to the origin of these ores, discussing matters relating to the production. 2500 w. B C Min Rec—June, 1903. No. 55-775 B.

MINING.

Ankylostomiasis.

The Extension of Ankylostomiasis in German Coal Mines. A statement of the gravity of this disease among the underground workers, and what is being done to combat it. 1500 w. Col Guard—June 5, 1903. No. 55790 A.

Excavating.

Mining and Other Excavating by Steam Shovels and Modern Electric and Steam Driven Dredges. Frank C. Perkins. An illustrated article describing systems now used, and giving examples of their application. 2500 w. Min Rept—June 11, 1903. No. 55813.

Exploration Work.

Test Drilling on the Mesabi Iron Range. Kirby Thomas. An illustrated account of the exploration work in progress. About 250 drills, of all classes, are employed. 2000 w. Eng & Min Jour—June 13, 1903. No. 55844.

Explosives.

A New Safety Explosive. Richard T. Dana. Gives tests made by the writer of an explosive, known as Joveite, having picric acid and sodium nitrate for the principal constituents, and reports its use, comparing it with other explosives. 3500 w. Pro Am Soc of Civ Engrs—May, 1903. No. 55769 E.

Testing Safety Explosives at Gelsenkirchen. Bergassessor Beyling, in *Glückauf*. Describes the method of testing and gives tabulated results. 800 w. Col Guard—May 22, 1903. No. 55537 A.

Freezing Process.

Sinking by the Freezing Method and Its Difficulties. Translated from *Glückauf*. Particulars given by R. Pierre of the difficulties met with in sinking by this process at the Laura and Vereeniging Colliery, in Holland. Ill. 4200 w. Ir & Coal Trds Rev—June 5, 1903. No. 55-804 A.

Head-Works.

Head-Works Framing. Charles H. Fitch. Outlines of framing used, discussing stresses. 1500 w. Min & Sci Pr—June 13, 1903. No. 56101.

Head-Works Framing—Primary Notions. Charles H. Fitch. Explanations of the stresses in tower frames. 1200 w. Min & Sci Pr—May 23, 1903. No. 55561.

Hydraulic Mining.

Hydraulic Mining in Southern Oregon. A. B. Cousin. A brief account of its history and possibilities. Ill. 2300 w. Pacific C Min—May 23, 1903. No. 55603.

Miner's Phthisis.

So-Called Anthracosis and Phthisis in Coal Miners. R. S. Trotter. From the *British Medical Jour.* Gives statements tending to show that coal dust is not the cause of these troubles, that phthisis is not common among miners, nor due to their occupation. 800 w. Ir & Coal Trds Rev—May 29, 1903. No. 55687 A.

Miner's Phthisis. Continued discussion of paper by William Cullen. 9500 w. Jour Chem & Met Soc of S Africa—April, 1903. No. 55668 E.

Mining Law.

The Rarus-Pennsylvania Case. R. W. Raymond. A reply to a criticism of an earlier article, discussing points in this recent decision. 1800 w. Eng & Min Jour—June 6, 1903. No. 55710.

Packing Mines.

The Hydraulic Packing of Coal Mines (Bergversatz mit Wasserspülung am Dreifaltigkeitsschachte). Karl Cizek. An address before the Mining and Metallurgical Society of Moravian Ostrawa, giving a description of the filling of the workings of the Trinity coal mine, in Polish Ostrawa, Austria, with material from the surface conveyed hydraulically, in order to get out the pillars left standing. 3000 w. Oesterr Zeitschr f Berg u Hüttenwesen (Supplement)—April 25, 1903, and also with plate, May 30, 1903. No. 56030 D.

Packing Goaf with Sand and Granulated Slag by the Flushing Process. C. Cizek, in *Oesterreichische Zeitschrift für Berg- und Hüttenwesen.* Describes this system, which has been successfully carried out, stating its advantages where applicable, and claiming a large recovery of coal. 700 w. Col Guard—June 12, 1903. No. 55871 A.

Quarrying.

Electricity in French Slate Quarries. Describes the former methods of working, and the recent method of working by electric power. Diagram. 2700 w. Engng—May 22, 1903. No. 55538 A.

Rockdrilling.

Compressed-Air vs. Electric Rock Drills (Die Gesteinsbohrmaschinenfrage im Jahre 1902. Druckluft und Elektricität). Q. Classen and Hugo Drolz. Discussion as to the relative advantages and costs of compressed-air and electric rock drills. 3500 w. Oesterr Zeitschr f Berg u Hüttenwesen—April 18, 1903. No. 56-027 D.

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Shaftsinking

Shaftsinking in the Ruhr Coal District, Germany (Schachtabteufen im Ruhrkohlenbezirk). An account of various methods of sinking shafts for coal mines and their cost, in Westphalia. 3000 w. Zeit schr d Oesterr Ing u Arch Vereines—June 5, 1903. No. 56023 B.

Southern States.

Southern Mining Impressions. An account of the development going on and improvements visible in the mining regions of the South. 4000 w. Mines & Min—June, 1903. No. 55569 C.

Speed Indicator.

See Mechanical Engineering, Miscellany.

Timbering.

Mining Methods and Safety Measures in the Wilczek Mines in Polish Ostrawa (Ueber einige Baumethoden auf den Gräflich Wilczekschen Gruben in Polnisch-Ostrau und über Sicherheitsmassnahmen bei Denselben). Josef Mauerhofer. Illustrated description of timbering and other mining methods and safety appliances in Austrian coal mines. Serial. 2 Parts. 1 Plate. 5000 w. Oesterr Zeitschr f Berg u Hüttenwesen—May 16 and 23 1903. No. 56033 D.

Tin.

Method of Removing Overburden at the New Brothers Home No. 1 Tin Mine, Tasmania. James B. Lewis. Illustrated description of these deposits and the method of removing the overburden and the stripping of the drift. 2500 w. Eng & Min Jour—May 30, 1903. No. 55578.

Wells.

Breathing Wells. W. H. Booth. Illustrations showing the principles governing their action which are of special interest to miners. 1200 w. Mines & Min—June, 1903. No. 55570 C.

MISCELLANY.

Aluminum.

Production of Aluminum in 1902. Joseph Struthers. From Mineral Resources of the United States, Calendar year 1902. Information relating to production, prices, imports, etc. 1800 w. Ir Trd Rev—June 18, 1903. No. 55883.

Bosnia-Herzegovina.

Mining and Metallurgy in Bosnia and Herzegovina in 1902 (Das Berg- und Hüttenwesen in Bosnien und Herzegovina im Jahre 1902). Statistical tables. 1000 w. Oesterr Zeitschr f Berg u Hüttenwesen—June 6, 1903. No. 56038 D.

Frank Disaster.

The Frank Disaster. Several accounts, with illustrations, of the rock slide on Turtle Mountain, which buried this mining town on the C. P. Railroad, and caused great loss of life. A vertical seam of coal was being worked. 4500 w. Can Min Rev—May 30, 1903. No. 55563 B.

The Great Rock-Slide at Frank, Alberta. William Pearce. An illustrated account of the disaster on the morning of April 29th, which buried this town and killed 66 men, women, and children, blocking the Canadian Pacific Ry. track for about a mile and a half. Also report of the official investigation. 3300 w. Eng News—June 4, 1903. No. 55626.

The Rock-Slide at Frank. Reports, with interesting illustrations, of this catastrophe, describing the features of interest, and the present condition of the locality. 2000 w. Can Engr—June, 1903. No. 55696.

Great Britain.

The Mineral Wealth of Great Britain. Editorial review based on the record in a recent Home Office report. 1200 w. Engng—May 22, 1903. No. 55541 A.

Lead Smelting.

A Native Lead Smelting Furnace, Mexico. A. H. Bromly. Read before the Inst. of Min. Engrs., England. Illustrates and describes a primitive smelting plant. 900 w. Min Rept—May 28, 1903. No. 55551.

Molybdenite.

Molybdenite—Its Occurrence, Concentration and Uses. J. Walter Wells. Gives results of experimental work to determine the different methods of concentrating the ores. Also its occurrence in Canada is reported, and its industrial uses considered. Ill. 5800 w. Can Min Rev—May 30, 1903. No. 55564 B.

Oil Concentration.

An Automatic Process of Oil Concentration in Successful Use in Peru and Bolivia. J. W. Van Meter. An illustrated description of an ore-concentrating plant at Yauli, Peru. It has a capacity of 40 tons daily. 1500 w. Pacific Coast Min—May 30, 1903. No. 56119.

Oil Field.

Beaumont Oil Field. H. H. Stock. An illustrated account of the recent fire and the present condition of the field and the development in progress. 2000 w. Mines & Min—June, 1903. No. 55567 C.

Ore Deposits.

Peculiar Mines and Ore Deposits of the Rosita and Silver Cliff Mining District of Colorado. A. M. Welles and Prof. Arthur Lakes. Illustrated description of the ore deposits in a volcanic throat. 4000 w. Mines & Min—June, 1903. No. 55566 C.

Peat.

The Peat Industry in Galicia (Torfverwertung in der Industrie). Jan Blauth Abstract of a report to an assembly in

Cracow, giving a review of the use of peat, particularly as a fuel, and of the development of the peat industry in Galicia. 2500 w Oesterr Wochenschr f d Oeff Baudienst—April 25, 1903. No. 56003 D.

Salt.

The Salt Industry in Austria, in 1900 (Die Salinen Oesterreichs im Jahre 1900). Abstract from a government report, giving statistics of salt mines and salt works and their operation, employees, etc. Serial. 3 Parts. 6000 w. Oesterr Zeitschr f. Berg u Hüttenwesen—April 4, May 9 and 16, 1903. No. 56025 each D.

The Occurrences of Salt in Roumania (Das Salzvorkommen in Rumänien). W. Teisseyre and L. Mrazec. A geological and general description of the salt beds and salt mines of Roumania. Illustrations and map. Serial. 4 Parts. 1 Plate. 6000 w. Oesterr Zeitschr f Berg u Hüttenwesen—April 11, 18, 25 and May 2, 1903. No. 56026 each D.

Rock Salt Mining in Kansas. W. R Crane. Describes the room- and pillar-system of mining employed. 2300 w. Eng & Min Jour—June 6, 1903. No. 55714.

Slate.

The Slate Quarries of East Liguria. An account of the slate quarries of Northern Italy and the improved methods of working made necessary by competition. 2000 w. Quarry—June, 1903. No. 55726 A.

Tin.

The Malay Tin Deposits. R. A. F. Penrose, Jr. Abstract of an article in the *Journal of Geology*. Considers the geographical position and general geology of the tin regions, the location of the Kinta district, mode of occurrences, origin, and commercial features. Ill. 3000 w. Eng & Min Jour—June 20, 1903. No. 55993.

The Sain Alto Tin Deposits. J. Nelson Nevius. Information of the tin deposits in Mexico, with statistics of the Sain Alto bills of sale for the last three years. 700 w. Eng & Min Jour—June 30, 1903. No. 55994.

Zinc Furnace.

A Furnace for the Continuous Distillation of Zinc and the Direct Working of the Residues (Kontinuierlicher Schachtzinkdestillierofen mit Direkter Verarbeitung der Rückstände). Hr. Schmieder. An illustrated description of a furnace and process which works continuously, prevents loss of material and is economical of labor. 1500 w. Oesterr Zeitschr f Berg u Hüttenwesen—April 25, 1903. No. 56029 D.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION.

Railroad Police.

The Railroad Police. Josiah Flynt. Showing the value and economy of a systematic police organization. 4000 w. R R Gaz—June 12, 1903. No. 55837.

Rules.

The Standard Code on the C. N. O. & T. P. Gives extracts from the rules for conductors, with remarks. 4800 w. R R Gaz—June 19, 1903. No. 55979.

MOTIVE POWER AND EQUIPMENT.

Air Pumps.

Economical Repairs to 9 ½ Inch Air Pumps. Otto Best. An account of what the writer considers the best practice. 1200 w. Ry Age—June 12, 1903. No. 55815.

Boilers.

Maintenance of Boilers and Roundhouse Work. Reynold C. Young. Read at Columbus Convention of International Ry. Master Boilermakers' Assn. Considers the causes that increase the cost of maintenance, and the repairs and care in roundhouse work. 1400 w. Ry & Engng Rev—June 6, 1903. No. 55700.

Brakes.

The Mechanics of Air-Brake Systems. H. G. Manning. Historical account showing that the systems in use differ only in small mechanical details, and discussing the points in which they differ. Ill. 2500 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55894 C.

Handling the New York Engineers' Brake Valve. Considers the proper method of handling this mechanism. 1500 w. Loc Engng—June, 1903. Serial. 1st part. No. 55614 C.

Car Frames.

Steel Frames for Cars. C. A. Seley. Gives a steel frame box car design, and discusses the use of steel in car construction. Ill. 1000 w. Am Engr & R R Jour—June, 1903. No. 55642 C.

Cars.

New Designs of 100,000-Lbs. Capacity Steel Gondola Car. E. W. Summers. Illustrated description. 700 w. Ry & Engng Rev—May 30, 1903. No. 55577.

We supply copies of these articles. See page 797.

Some Notes on Steel Car Repairing. Describes the arrangements and methods at some of the shops identified with the early history of these cars. 2400 w. R R Gaz—June 5, 1903. No. 55659.

Couplers.

A New Automatic Buffer Coupling. Charles Rous-Marten. An illustrated description of the Allison Smith automatic buffer coupler. Engr, Lond—May 22, 1903. No. 55546 A.

Roe's "Bull's Eye" Coupler and Central Buffer Draw Gear. An illustrated description of an automatic railway coupling now undergoing tests at the trials by the Russian railway officials. 500 w. Prac Engr—June 5, 1903. No. 55724 A.

Dynamometer Car.

The Orleans Dynamometer Car. Mr. Huet. An illustrated description, translated from the *Revue Générale des Chemins de Fer.* 2300 w. R R Gaz—June 19, 1903. No. 55982.

Dynamometer Tests.

Dynamometer Tests on the Canadian Pacific Railway. L. J. Houston, Jr. An illustrated article giving an account of tests made between Fort William and Winnipeg, with information concerning the traffic. Tables and plates. 3000 w. Trans Assn of Civ Engrs of Cornell Univ—1903. No. 55928 F.

Lignite Fuel.

Lignite Burning in Locomotives. M. H. Wickhorst. Gives results of experience with the burning of lignite coal in locomotives in Montana, with methods and results of smoke-box analyses. Ill. 1200 w. Am Engr & R R Jour—June, 1903. No. 55647 C.

Locomotive Operation.

Leaky Flues and Circulation in Wide Firebox Locomotives. John Player. Discusses the causes of trouble, the chief being the class of fuel used, the inexperience of firemen and engineers, and the ignorance of those in charge at terminals. 1500 w. Am Engr & R R Jour—June, 1903. No. 55646 C.

Locomotives.

British Locomotives for Abroad. Charles Rous-Marten. Discusses the locomotive industry of Great Britain, giving illustrations of British engines recently constructed for the export trade. 4000 w. Page's Mag—June, 1903. Serial. 1st part. No. 55911 B.

Compound Consolidation Locomotive for the Southern Pacific. Illustrated description of large recently built engines. The principal new feature is the semi-cylindrical tender for oil and water. 400 w. Ry Age—June 5, 1903. No. 55699.

Compound Passenger Locomotives, 4-4-2 Type. Diagrams and description of Vauclain four-cylinder balanced compound locomotives for the A., T. & Santa Fe Ry. 600 w. Am Engr & R R Jour—June, 1903. No. 55643 C.

Four-Cylinder Compound Goods Locomotive. Illustrated description of engine used for heavy express trains on the L. & N. W. Ry. 300 w. Engr, Lond—May 29, 1903. No. 55683 A.

Freight Locomotives of the Kansas City Southern Railway. Line drawings, photograph and general description of one of five recently built engines. 800 w. Ry Mas Mech—June, 1903. No. 55690.

French Express Engine for an English Railroad. Brief illustrated description of the type of new four-cylinder compound express engine building for the Great Western Ry., England. 600 w. Sci Am—June 20, 1903. No. 56106.

Heavy Eight-Wheel Passenger Engines for the Delaware & Hudson. Illustrated detailed description with general dimensions and remarks on this type of engine. 800 w. Ry Age—June 12, 1903. No. 55814.

Large Locomotives. A summary of opinions in regard to their service and the causes of failures, with editorial comment. 4000 w. Ry Age—May 29, 1903. No. 55574.

New Passenger Locomotives for the Chicago & Alton Ry. Illustrated description of heavy engines designed to make long runs with heavy trains at high speed. 1500 w. Eng News—May 28, 1903. No. 55589.

Pennsylvania R. R. Standard Passenger Locomotives. Describes an engine representing the highest type of construction thirty-five years ago, and also the most recent locomotives of the road named. These are of the 4-4-2 type wide firebox, Belpaire boiler, passenger locomotives for heavy and fast work. 2500 w. Ry & Engng Rev—June 20, 1903. No. 56100.

Steam Distribution of the Vauclain Compound Locomotive. Lawford H. Fry. Introductory description, showing how the theoretical diagram given, constructed by Zeuner's method, represents the processes through which the steam passes. 3000 w. R R Gaz—May 29, 1903. No. 55593.

Switching Locomotives. Pittsburg, Shawmut & Northern Railroad. Illustrates and describes a medium size engine intended for heavy switching service where there are sharp curves and heavy grades. 500 w. Ry Age—May 29, 1903. No. 55573.

Tendencies in Locomotive Design. A review of the development of the different types, showing the conditions that had to

We supply copies of these articles. See page 797.

be met and the expedients used, and describing notable engines. 1 plate. 5500 w R R Gaz—June 19, 1903. No. 55980.

The Proportions of Modern Locomotives. Lawford H. Fry. Gives tabulated results of investigations of over 200 modern locomotives of all classes, with notes. 1500 w. Am Engr & R R Jour—June, 1903. No. 55645 C.

The Steaming Capacity of Locomotives. Editorial, reviewing briefly some of the methods proposed for comparing the steaming capacity of locomotives, and giving methods of making the calculations. 2700 w. R R Gaz—June, 1903. No. 55986.

Why Foreign Locomotives May Be More Efficient Than Ours. W. A. Buckbee. Thinks they have given more attention to smoke-box arrangement and heating service. 1200 w. Loc Engng—June, 1903. No. 55613 C.

Locomotive Tractive Power.

Chart for Tractive Power of Locomotives. Diagram, with description of its construction and use. 400 w. Am Engr & R R Jour—June, 1903. No. 55649 C.

Oil Burning.

Oil Burning Atlantic (4-4-2) Type Locomotive for the Southern Pacific. Illustration, with brief description. 150 w. R R Gaz—June 12, 1903. No. 55838.

Painting Locomotives.

Locomotive Painting. Extracts from a paper read at the April meeting of the Northwest Ry. Club, by C. J. Bishop. Gives formulae, and directions for securing protection and durability. 2500 w. R R Gaz—June 19, 1903. No. 55985.

Smoke Prevention.

Modern Equipment of Locomotives for the Prevention of Smoke—Using Coal or Oil as Fuel. W. M. Best. Considers the equipments of coal-burning and of oil-burning locomotives, favoring the latter. 3000 w. Pro Pacific Coast Ry Club—May 16, 1903. No. 55922.

Steam Car.

A Steam Railway Car. An illustrated description of a steam passenger car used on the London and South-Western Ry. for local traffic in the neighborhood of Portsmouth. 1700 w. Engng—May 22, 1903. No. 55539 A.

Suburban Cars.

Steel-Frame, Side-Door, Suburban Passenger Cars. Describes cars being built for the Illinois Central upon a new plan; the basis of construction is the use of side doors. 1800 w. Ill. Am Engr & R R Jour—June, 1903. No. 55641 C.

Superheating.

See Mechanical Engineering, Steam Engineering.

Tender.

Tender for Compound Locomotive; Mediterranean Railway, Italy. Two-page plate of sectional views, with illustration and details of tender, chief dimensions, weights, etc., of these recently constructed engines. 1000 w. Engng—June 5, 1903. No. 55793 A.

Train Resistance.

A Rational Train Resistance Formula. John Balch Blood. A brief history of train resistance formulae and their development, with discussion of each. 3000 w. Trans Am Soc of Mech Engrs—June, 1903. No. 55901.

NEW PROJECTS.

Switzerland.

The Railway from Reichenau to Ilanz, Switzerland (Die Neuen Linien der Rhätischen Bahn. Die Bahn Reichenau-Ilanz). P. Saluz. An illustrated description of the construction of a short railway up the Hitler Rhine valley in eastern Switzerland. Map and profile. Serial. 2 parts. 4500 w. Schweiz Bauzeitung—May 30, June 6, 1903. No. 56045 each D.

The Railway from Erlenbach to Zweisimmen, Switzerland (Die Lokalbahn Erlenbach-Zweisimmen). K. Becker. An illustrated description of a railway in the Simmenthal, forming a link of a direct line between Lakes Thun and Geneva, and its construction. Map and profile. 2500 w. Schweiz Bauzeitung—May 2, 1903. No. 56042 D.

Tropics.

Railway Building in the Tropics. John L. Caspar. An illustrated article on the construction of the Northern Railway of Guatemala, and the Honduras Railway. 2800 w. Gunton's Mag—June, 1903. No. 55744.

Utah.

Line Changes on the Rio Grande Western Ry., in Utah. W. P. Hardesty. Briefly outlines the history of the road, and describes the improvements made and proposed. Ill. 2200 w. Eng News—June 4, 1903. No. 55628.

PERMANENT WAY AND FIXTURES.

Gates.

Improvements in Gates at Crossings (Neuerungen an Wegeschranken). Hr. Scholkmann. A paper before the Verein für Eisenbahnkunde, giving an account of improvements in hand-operated gates for railway grade crossings, and an illustrated description of an automatic gate worked by gas engine. 2000 w. Glasers Annalen—June 1, 1903. No. 56084 D.

Rail Re-Rolling.

See Mechanical Engineering, Machine Works and Foundries.

We supply copies of these articles. See page 797.

Roundhouse.

New Roundhouse of the Baltimore and Ohio Railway. Illustrated detailed description of a building to be erected at Holloway, Ohio. 1200 w. Ry Mas Mech —June, 1903. No. 55691.

Shops.

Proposed Extension of Lehigh Valley Railroad Shops at Sayre, Pa. Outlines the proposed plan for the gradual extension and rearrangement of the plant. 1000 w. Eng Rec—May 30, 1903. No. 55583.

The Great Northern Shope at St. Paul. Full illustrated detailed description of these shops. 2-page plate. 4000 w. R R Gaz—June 19, 1903. No. 55978.

Signalling.

Automatic Railway Signalling. Illustrates and describes the London & South-Western railway company's installation at Salisbury. 2000 w. Transport—May 29, 1903. No. 55661 A.

Col. Yorke on Automatic Signalling. The reply of H. A. Yorke in explanation of points misunderstood, and in reply to criticisms of his views as expressed in his recent report. 1800 w. Ry Age—June 19, 1903. No. 55999.

Electric Locking for Levers of Interlocking Machines. How best to use electric locking and the advantages. Ill. 2200 w. Ry Age—June 12, 1903. No. 55816.

Gillmor's Automatic Switch Lock. An illustrated description of the construction and operation. 1200 w. R R Gaz—June 12, 1903. No. 55839.

The Hall Electro Gas Signal. An illustrated description of the apparatus for working the Hall Semaphore signals by gas motors. 1700 w. R R Gaz—June 5, 1903. No. 55658.

The Marin Signal System for Railways (Das System Marin zur Sicherung Fahrender Eisenbahnzüge). Hr. Raffalovich. A paper before the Verein für Eisenbahnkunde, giving an illustrated description of a signaling system which automatically causes the locomotive whistle to blow, besides showing a visual signal. 2500 w. Glasers Annalen—June 1, 1903. No. 56085 D.

Electric Automatic Blocksignals on the Bannstein-Muttershausen Local Railway in Lorraine (Elektrisch Selbsttätige Blocksignale der Industrialbahn "Bannstein-Muttershausen" in Lothringen). L. Kohlfürst. A description, with diagram, of an electric signal system, designed by Georg Schreiber, on a short single-track branch railway, connecting an industrial works with a main line. 3000 w. Zeitschr f Elektrotechnik—April 26, 1903. No. 56047 D.

Clayton's Fog-Signalling Apparatus. An illustrated description of a mechanical apparatus for use on railways. 1100 w. Engng—June 5, 1903. No. 55792 A.

TRAFFIC.

Car Service.

Demurrage. A. W. Sullivan. Extracts from an address on "Car Service in Its Relation to Operation," delivered before the Nat. Assn. of Car Service Mgrs., at Chicago. 1300 w. R R Gaz—June 19, 1903. No. 55987.

MISCELLANY.

Expenses and Rates.

The Relations Between Operating Expenses and Rates (Die Beziehungen Zwischen Betriebkosten und Tarifen). E. Fränkel. A paper before the Verein für Eisenbahnkunde, giving a discussion of the proper distribution of operating expenses of railways, and their relations to rates. 3000 w. Glasers Annalen—June 1, 1903. No. 56083 D.

India.

Indian Railways. Reviews the report of Mr. Thos. Robertson, appointed as a special commissioner to inquire into the working of the system. 1600 w. Engr, Lond—June 12, 1903. No. 55943 A.

Queensland.

Queensland Railways and Colonial Development. Editorial discussion of the working of the State Railways, and the conditions they must meet. 1800 w. Engng—June 5, 1903. No. 55795 A.

St. Louis.

Affairs of the Terminal Railroad Association of St. Louis. A statement aiming to explain the relations of this association to the merchants and manufacturers. 3000 w. Ry & Engng Rev—May 30, 1903. No. 55576.

STREET AND ELECTRIC RAILWAYS

Accidents.

The Accident Record and Resultant Disbursements of the Milwaukee Electric Railway and Light Company. Quotes decisions of the highest court of Wisconsin, gives tabulated classification of accidents by months, and the amounts paid in connection therewith, and other financial statistics. 2000 w. St Ry Jour—June 20, 1903. No. 56104 D.

Accumulator Traction.

The Use of Accumulators for Traction

We supply copies of these articles. See page 707.

Purposes (Die Verwendung von Akkumumulatoren zum Fahrbetrieb). W. v. Winkler. A general discussion of traction by means of storage batteries, of the batteries themselves, and of the conditions for success. Diagrams. Serial. 2 parts. 4500 w. Zeitschr f Elektrotechnik—May 31, June 7, 1903. No. 56053 each D.

Berlin--Lichterfelde.

Electric Traction on the Suburban Railway from Berlin to Gross-Lichterfelde-Ost (Die Elektrische Zugförderung der Vorortbahn Berlin - Gross - Lichterfelde - Ost). Kurt Meyer. Well illustrated description of the electrical equipment of a third-rail, direct-current road, about 6 miles long. Serial. Part 1. 4000 w. Zeitschr d Ver Deutscher Ing—June 6, 1903. No. 56078 D.

Electric Traction on Main Railways and the Electric Equipment of the Berlin-Gross Lichterfelde Ost Suburban Railway (Die Bisherigen Ergebnisse des Elektrischen Betriebes auf Hauptbahnen und die Einrichtung der Gegenwärtig in Ausführung Begriffenen Elektrischen Zugförderungsanlage für die Vorortstrecke Berlin-Gr. Lichterfelde Ost). Hr. Bork. Paper before the Verein für Eisenbahnkunde, giving a discussion of electric traction on main lines, and a well illustrated description of the electric equipment and rolling stock of a third-rail direct-current railway out of Berlin. 1 plate. 9000 w. Glasers Ann—May 15, 1903. No. 56082 D.

Canal Haulage.

A New System for Electric Haulage on Canals (Ueber ein Neues System für Elektrischen Schiffszug auf Kanälen). Julius Szász. An illustrated description of the system proposed by Ganz & Co. for the Teltow Canal, near Berlin, in which there is a locomotive with inclined axles and four wheels which run on a single rail. Three-phase current is used. Serial. 2 parts. 4500 w. Zeitschr f Elektrotechnik —May 3 and 10, 1903. No. 56049 each D.

Electric Haulage on Canals. Frank C. Perkins. Considers some of the work in this field, and the results of competition for haulage on the Teltow Canal. 3500 w. Elec Rev, N Y—June 6, 1903. No. 55703.

Electric Haulage on Canals. Frank C. Perkins. Considers work done in electric canal haulage, and gives an illustrated detailed account of the tests of systems made on the Teltow Canal, in Germany. 2000 w. Sci Am—June 27, 1903. No. 56147.

Chicago Terminal.

Fifty-second Avenue Terminal in Chicago. Brief illustrated description of an elaborate terminal station for the transfer of passengers, and storage of cars. 700 w. St Ry Jour—June 6, 1903. No. 55706 D.

Conduit System.

The London County Council Tramways —A Defence of the Conduit System. Considers the various objections made to the system. 1600 w. Elec Engr, Lond—May 22, 1903. No. 55535 A.

Freight Car.

Construction and Operation of a Freight-Car Driven by Induction Motors. A. B. Weeks. Describes the method of supporting trolley wires, the supply circuit, controllers, etc., for operating a flat car in a factory. 2000 w. St Ry Jour—June 6, 1903. No. 55708 D.

Interurban.

A Remarkable Iowa Interurban. Illustrated description of the Colfax branch of the system of the Interurban Ry. Co. of Des Moines, Iowa, which is of interest because of the remarkable amount of traffic in a sparsely populated territory. 2400 w. St Ry Jour—June 20, 1903. No. 56103 D.

Electric Interurban for Freight and Passengers. An illustrated detailed account of the recently opened section between Scranton and Pittston, of the Lackawanna & Wyoming Valley Railway. 7500 w. St Ry Jour—June 13, 1903. No. 55822 D.

Rockford & Interurban Railway Co. An illustrated article dealing with the growth and development of this Illinois system, the railways included in the new consolidated company, the organization, operating features, etc. 5500 w. St Ry Jour—June 20, 1903. Serial. 1st part. No. 55997 C.

The Lackawanna and Wyoming Valley Railroad. A brief general description, with illustrations, of a 35-mile, double-track, third rail line built and equipped for carrying freight and passengers. 3800 w. Eng Rec—June 13, 1903. No. 55846.

London.

The Electrification of the Underground. Wilfred Yorke. An illustrated description of the section from North Ealing to South Harrow. 2000 w.. Elec Rev, Lond —June 5, 1903. No. 55783 A.

Mersey, Eng.

Electric Traction on the Mersey Railway (Traction Electrique dans le Tunnel de la Mersey). Ch. Dantin. A well illustrated description of the electric railway under the Mersey, between Liverpool and Birkenhead, and its equipment. 6000 w. Génie Civil—May 16, 1903. No. 56150 D.

The Electrification of the Mersey Railway. An illustrated description of the replacing of steam power by electricity on an English suburban railway. 4800 w. Feilden's Mag—June, 1903. No. 55914 B.

We supply copies of these articles. See page 797.

Montreal.

Recent Additions to the Generating Plant of the Montreal Street Railway. Ralph D. Mershon. Illustrates and describes the addition of machinery and switchboard apparatus required for receiving power transmitted from hydraulic generating plant 17 miles distant. 900 w. St Ry Jour—June 6, 1903. No. 55707 D.

New York.

The Transportation Problem of Greater New York. W. W. Wheatley. A review of the present conditions, an outline of the transportation problem, with a sketch of the plans already formed for its solution, indicating the effect upon the metropolitan population. General discussion. 17000 w. N Y R R Club—May 15, 1903. No. 55923.

Section 4, New York Rapid Transit R. R. An illustrated description of the work from 34th to 41st St. It has two separate double-track, concrete-lined, rock tunnels, driven below the existing double-track street car tunnel. 2200 w. Eng Rec —June 6, 1903. Serial. 1st part. No. 55716.

North-Eastern Ry.

Electrical Traction on the North-Eastern Railway. An account of the proposed equipment for suburban traffic in the neighborhood of Newcastle-upon-Tyne. Ill. 2000 w. Elect'n, Lond—May 29, 1903. No. 55673 A.

Staten Island.

The Proposed Terminal at St. George, Staten Island. A statement of the recent propositions made by the steam and the electric transportation companies to furnish ferry service, with an illustrated description of the accepted plans. 1000 w. St Ry Jour—May 30, 1903. No. 55557 D.

Surface Contact.

Surface Contact Systems for Electric Street Railways (Knopfkontactsysteme für Elektrische Strassenbahnen). Josef Löwy. A paper giving an illustrated description of many of the surface-contact systems, and particularly of the electromagnetic system of Dr. Hillischer, of Vienna. Also, discussion. Serial. 2 parts. 4500 w. Zeitschr f Elektrotechnik—May 17 and 31, 1903. No. 56051 each D.

General Electric Company's Surface-Contact System. Illustrated description of this system, which consists of two rows of metal contacts, bedded in the pavement, and brought into connection with the car through the agency of light steel skates. The contacts of one row is energized by the car, those of the other supply power to the car. 4500 w. Engng—May 29, 1903. No. 55686 A.

The Magnetic Surface-Contact System. G. Paul. Points out some of the failings of this system and makes a comparison of the Diatto and the Lorain systems. Ill. 2300 w. Elec Engr, Lond—May 29, 1903. No. 55676 A.

Third-Rail.

The First Third-Rail Electric Railway in Italy. Enrico Bignami. An illustrated description of the Varese Railway system and its equipment. 4000 w. Elec Rev, N Y—May 30, 1903. No. 55595.

Trolley Trips.

From New York to Boston by Trolley. Gives four maps showing the electric railways in operation, proposed, and under construction, and the steam railroads. The trip can be made by electric railways with the exception of about 4 miles. Time, 20 hours and 5 minutes. Fare, $2.85. 300 w. St Ry Jour—June 20, 1903. No. 56105 D.

Short Vacations by Trolley. Albert Bigelow Paine. An illustrated article on the pleasures of trolley travel, describing principally the route between New York and Boston. 2500 w. World's Work—July, 1903. No. 56123 C.

Trucks.

Trucks for High Speed Electric Railroads. An interesting reiew of the development, with illustrations of many types for high speed service. 4000 w. R R Gaz —June 19, 1903. No. 55983.

Valtellina.

The Three-Phase Railway at Valtellina. An illustrated description of the electrical equipment and novel features of this Italian line, and its operation. 3500 w. St Ry Jour—May 30, 1903. No. 55556 D.

The Valtellina Electric Railway. Emile Guarini. An interesting account of the working of this line in Italy, and of the difficulties and trials, with related matter. 2700 w. Ry Age—May 29, 1903. No. 55575.

Vesuvius.

The Vesuvius Railway (Die Vesuvbahn). E. Strub. A well illustrated description of a combined adhesion, rack and cable railway up Mount Vesuvius, Italy, operated by electric current which is generated in a station with gas-engines and direct-current generators. Serial. 4 parts. 12000 w. Schweiz Bauzeitung—April 18, 25, May 9, 16, 1903. No. 56041 each D.

Wheels.

The Shape of Wheels on Electric Railways (Neigungswinkel des Laufradprofiles bei Elektrischen Bahnen). K. Sieber. A discussion of the influence of the degree of coning of wheels on the vibrations of cars and the wear of wheels and rails, and the best shape for wheels. 2500 w. Zeitschr d Ver Deutschr Ing—June 6, 1903. No. 56081 D

We supply copies of these articles. See page 797.

EXPLANATORY NOTE—THE ENGINEERING INDEX.

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

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THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* Boston.
American Electrician. *m.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Gas Light Journal. *w.* New York.
American Jl. of Science. *m.* New Haven, U.S.A.
American Machinist. *w.* New York.
American Shipbuilder. *w.* New York.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. d Ing. e d Arch. Ital. *w.* Rome.
Architect. *w.* London.
Architectural Record. *qr.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Sydney.
Autocar. *w.* Coventry, England.
Automobile. *m.* New York.
Automobile Magazine. *m.* New York.
Automotor & Horseless Vehicle Jl. *m.* London.
Beton und Eisen. *qr.* Vienna.
Brick Builder. *m.* Boston.
British Architect. *w.* London.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bulletin American Iron and Steel Asso. *w.* Philadelphia, U. S. A.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. Soc. Int. d Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *m.* Montreal.
Canadian Mining Review. *m.* Ottawa.
Cassier's Magazine. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Deutsche Bauzeitung. *b-w.* Berlin.
Domestic Engineering. *m.* Chicago.
Electrical Engineer. *w.* London.
Electrical Review. *w.* London.

Electrical Review. *w.* New York.
Electrical World and Engineer. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Electricity. *w.* London.
Electricity. *w.* New York.
Electrochemical Industry. *m.* Philadelphia.
Electrochemist and Metallurgist. *w.* London.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elettricita. *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m.* Cleveland, U. S. A.
Engineering. *w.* London.
Enginering and Mining Journal. *w.* New York.
Enginering Magazine. *m.* New York & London.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U.S.A.
Feilden's Magazine. *m.* London.
Fire and Water. *w.* New York.
Foundry. *m.* Cleveland, U. S. A.
Gas Engineers' Mag. *m.* Birmingham.
Gas World. *w.* London.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giorn. Dei Lav. Pubb. e. d. Str. Ferr. *w.* Rome.
Glaser's Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Ice and Refrigeration. *m.* New York.
Ill. Zeitschr. f. Klein u. Straussenbahnen. *s-m.* Berlin.
Ingeneria. *b-m.* Buenos Ayres.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron and Steel Trades Journal. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. Am. Foundrymen's Assoc. *m.* New York.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal of Electricity. *m.* San Francisco.
Journal Franklin Institute. *m.* Philadelphia.
Journal of Gas Lighting. *w.* London.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Journal of Sanitary Institute. *qr.* London.
Journal of the Society of Arts. *w.* London.
Journal of U. S. Artillery *b-m.* Fort Monroe, U.S.A.
Journal Western Soc. of Eng. *b-m.* Chicago.
Journal of Worcester Poly. Inst., Worcester, U.S.A.
Locomotive. *m.* Hartford, U. S. A.
Locomotive Engineering. *m.* New York.
Machinery. *m.* London.
Machinery. *m.* New York.
Madrid Cientifico. *t-m.* Madrid.
Marine Engineering. *m.* New York.
Marine Review. *w.* Cleveland, U. S. A.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metallographist. *qr.* Boston.
Metal Worker. *w.* New York.
Métallurgie. *w.* Paris.
Minero Mexicano. *w.* City of Mexico.
Minerva. *w.* Rome.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci Press. *w.* San Francisco.
Mining Reporter. *w.* Denver, U. S. A.
Mitt. aus d Kgl Tech. Versuchsanst. Berlin.
Mittheilungen des Vereines für die Förderung des Local und Strassenbahnwesens. *m.* Vienna.
Modern Machinery. *m.* Chicago.
Monatsschr. d Wurtt. Ver. f Baukunde. *m.* Stuttgart.
Moniteur Industriel. *w.* Paris.
Mouvement Maritime. *w.* Brussels.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *m.* New York.
Nature. *w.* London.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Nineteenth Century. *m.* London.
North American Review. *m.* New York.
Oest. Wochenschr. f. d. Oeff Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg- & Hüttenwesen. *w.* Vienna.
Ores and Metals. *w.* Denver, U. S. A.
Pacific Coast Miner. *w.* San Francisco.
Page's Magazine. *m.* London.
Plumber and Decorator. *m.* London.
Popular Science Monthly. *m.* New York.
Power. *m.* New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Procedings Engineers' Club. *qr.* Philadelphia.
Pro. St. Louis R'Way Club. *m.* St. Louis, U. S. A.
Progressive Age. *s-m.* New York.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railroad Gazette. *w.* New York.
Railway Age. *w.* Chicago.
Railway & Engineering Review. *w.* Chicago
Review of Reviews. *m.* London & New York.
Revista d Obras. Pub. *w.* Madrid.
Revista Tech. Ind. *m.* Barcelona.
Revue de Mécanique. *m.* Paris.
Revue Gen. des Chemins de Fer. *m.* Paris.
Revue Gen. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Revue Technique. *b-m.* Paris.
Revue Universelle des Mines. *m.* Liége.
Rivista Gen. d Ferrovie. *w.* Florence.
Rivista Marittima. *m.* Rome.
Schiffbau. *s-m.* Berlin.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Engng. *m.* Ithaca, N. Y.
Stahl und Eisen. *s-m.* Düsseldorf.
Steam Engineering. *m.* Chicago.
Stevens' Institute Indicator. *qr.* Hoboken, U.S.A.
Stone. *m.* New York.
Street Railway Journal. *m.* New York.
Street Railway Review. *m.* Chicago.
Tijds. v h Kijk. Inst. v Ing. *qr.* Hague.
Traction and Transmission. *m.* London.
Tramway & Railway World. *m.* London.
Trans. Am. Ins. Electrical Eng. *m.* New York.
Trans. Am. Ins. of Mining. Eng. New York.
Trans. Am. Soc. Mech. Engineers. New York.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Transport. *w.* London.
Wiener Bauindustrie Zeitung. *w.* Vienna.
Yacht. *w.* Paris.
Zeitschr. d. Mitteleurop. Motorwagen Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *w.* Halle a S.
Zeitschr. f. Electrotechnik. *w.* Vienna.

CURRENT RECORD OF NEW BOOKS

NOTE—Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post-Office Orders, home and foreign, should be made payable to THE ENGINEERING MAGAZINE.

Electric Mining.

Electricity as Applied to Mining. By Arnold Lupton, G. D. Aspinall Parr and Herbert Perkin. Size, 9 by 6 in.; pp. vii, 280; figures, 171. Price, 10s. 6d. ($3.50). New York: D. Van Nostrand Company. London: Crosby Lockwood & Son.

As is remarked in the preface of this book, the use of electricity in mining twenty-five years ago was confined to signalling and shot-firing; twenty years ago only the beginnings of electric lighting had been made, and the applications of electric power came still later. But in recent years the use of electricity in various forms in and about mines has become so extensive that the collection of a great deal of valuable information, widely scattered through periodicals and the transactions of engineering societies, into a single volume is most timely and convenient. In the present work, after a general introduction on electricity and electrical apparatus, there are sections on electric generators and their driving; different prime movers, including the steam turbine; the distribution of electric energy; electric motors; electric cables; electric pumping and hauling; electric coal cutting; electric lighting; electric drilling; electric welding; and miscellaneous applications of electricity. There is also a discussion of electricity as compared with other methods of transmitting power; and the dangers of electricity and the methods of obviating them are considered.

Financial Electric Management.

The Finances of Gas and Electric Light and Power Enterprises. Second Edition. By William D. Marks, Ph. B., C. E. Size, 7 by 5 in.; pp. iii, 125; plates, 2. Price, $1. Philadelphia: Wm. D. Marks.

The commercial management of an electrical enterprise is at least as important to the owners and to the public as is its engineering design, but successful commercial management must be based on an appreciation of the various technical questions involved. The present book has been written from the standpoint of a man who has had experience as a manager of a large electric station, and who is therefore well able to view the electric supply business in both its financial and its engineering aspects. He gives a commercial analysis of small and unprofitable electric lighting, traction and power enterprises, and shows how they can be put upon a paying basis. Large central-station systems are also considered, and there is an extended discussion of methods of establishing fair prices for electric service, in which the subject of electric meters is reviewed. There are tables giving data of the electric light companies in Massachusetts, and the 1901 report of the gas commissioners of that State is analyzed and discussed, and deductions as to the proper price for gas drawn from it. There is a consideration of the subject of district steam and hot-water heating from electric central stations, and the conclusion arrived at that when properly designed such a system will pay. Although some of the author's opinions are open to controversy, this little book, as a whole, will prove very suggestive to the central station manager, and will give some valuable points to the intending investor in electrical enterprises.

River Improvement.

The Improvement of Rivers. A Treatise on the Methods Employed for Improving Streams for Open Navigation, and for Navigation by Means of Locks and Dams. By B. F. Thomas and D. A. Watt. Size, 12 by 9½ in.; pp. xiv, 356. Figures in the text, and 92 full-page and folding plates. Price, $6; postage, 47 cents additional. New York: John Wiley & Sons. London: Chapman & Hall, Ltd.

The improvement of internal waterways is attracting more and more attention, both in this country and abroad, and that branch of hydraulic engineering relating to the regulation and canalization of rivers, in particular, has made great progress within recent years. But in spite of the importance of the latter subject, there has hitherto been no systematic treatment of it in the English language, its principal literature being of Continental origin, with British and American monographs, reports and papers on special features of it. The object of the present comprehensive work is to provide in concise form a description of the various systems employed for bettering the condition of navi-

gable streams, together with the methods usually adopted for their design and execution. It has been endeavored to include all the important points of design and construction which are liable to be met with, and all calculations have been so simplified as to bring them within the range of those who have not received a thorough technical education, while at the same time this clear and plain treatment does not lessen the great value of the book to trained engineers. The first part of the volume relates to the preliminaries to river improvement and to surveying. The second part treats more particularly of the improvement of open rivers, and has chapters devoted, respectively, to the removal of bars and other obstructions; regularization; dikes and their effects; protection of banks; levees; storage reservoirs; and the improvement of river outlets. The third part, on the improvement of rivers by canalization, is the principal one, and here the authors speak with peculiar authority, for they have been actively engaged in the United States Government work of improving and canalizing the Ohio River and its tributaries. When these improvements are completed, there will here be the largest system of movable dams in the world, and the treatment of these engineering structures is therefore particularly full, the descriptions and illustrations of the latest and most modern types being of great excellence. The book is well and attractively made in every respect, and this, combined with its high intrinsic merit, will commend it most heartily to hydrographic engineers in particular and to the engineering profession in general.

Hydraulics.

Treatise on Hydraulics. By Mansfield Merriman. Eighth Edition. Size, 9¼ by 6 in.; pp. viii, 585; figures, 199. Price, $5. New York: John Wiley & Sons. London: Chapman & Hall, Ltd.

Prof. Merriman's standard treatise on hydraulics, of which this is the eighth edition, is too well known to require any extended description, and too favorably known to need any praise. It will suffice to call attention to some of the changes that have been made since the last edition was issued. Two new chapters have been added, one on Hydraulic Instruments and Observations, which treats of the methods of measuring pressures and velocities, and another on Pumps and Pumping, in which the various machines for raising water are discussed from a hydraulic point of view. Among the new topics introduced in the other chapters may be noted the vortex whirl that occurs in emptying a vessel, new coefficients for dams and for steel and wood pipes, the loss of head in pipes due to curvature, branched circuits or diversions in pipe systems, the influence of piers in producing backwater, canals for water-power plants, discharge curves for rivers, the tidal and the land bore, water-supply estimates, water hammer in pipes, the stability of a ship, and hydraulic-electric analogies. Many new examples and problems are given and in these the author has endeavored not only to exemplify the theory of the subject, but also to illustrate the conditions of actual practice. Historical notes and references to hydraulic literature are presented with greater fullness than before. The hydraulic tables have been gathered togetner at the end of the volume, instead of being scattered throughout the text, and the most important tables are presented both in the English and in the metric system, the latter not being a mere transformation of the former, but being arranged to be used with metric arguments. The principal metric data, coefficients, formulas, and problems are also given at the end of each chapter. While the main purpose in rewriting the book has been to keep it abreast with modern progress, a successful attempt has also been made to present the subject more concisely and clearly than before, in order to advance the interests of thorough education and to promote sound engineering practice.

BOOKS ANNOUNCED.

Ventilation in Mines. By Robert Wabner. Translated from the German by Charles Salter. Price, 10s. 6d. ($4.50). London: Scott, Greenwood & Co., New York: D. Van Nostrand Company.

The American Steel Worker. By E. R. Markham. Price, $2.50. New York: The Derry-Collard Company.

Die Herstellung der Akkumulatoren. By F. Grünwald. Price, 3 marks ($1). Halle a. S., Germany: Wilhelm Knapp.

Photographic Lenses. A Simple Treatise. Second Edition. By Conrad Beck and Herbert Andrews. Price, 75 cents. London: R. & J. Beck, Ltd., and Percy Lund, Humphries & Co., Ltd. New York: Tennant & Ward.

Experiments on the Flexure of Beams. By Albert E. Guy. Price, $1.25. New York: D. Van Nostrand Company. London: Crosby Lockwood & Son.

Specifications for Material and Workmanship for Steel Structures. Adopted at the 1903 Convention of the American Railway Engineering and Maintenance of Way Association. Price, single copies, 10 cents; for ten or more copies on one order, 5 cents each. Chicago: E. H. Fritch, Secretary pro tem., 1562 Monadnock Block.

NEWS SUPPLEMENT

The Engineering Magazine—August, 1903

Coming Society Meetings.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Sec.: Ralph W. Pope, 95 Liberty St., New York. Regular meeting on fourth Friday of each month, except June, July and August, 12 W. 31st St., New York.

AMERICAN INSTITUTE OF MINING ENGINEERS. Sec.: R. W. Raymond, 99 John St., New York. Next meeting, October, at New York.

AMERICAN RAILWAY ASSOCIATION. Sec.: W. F. Allen, 24 Park Place, New York. Next meeting Oct. 28, at Richmond, Va.

AMERICAN RAILWAY MECHANICAL AND ELECTRICAL ASSOCIATION. Sec.: Walter Mower, Detroit. First annual meeting, Sept. 1-4, Saratoga Springs, N. Y.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Sec.: C. W. Hunt, 220 W. 57th St., New York. Regular meetings, first and third Wednesdays of each month, except July and August.

AMERICAN STREET RAILWAY ASSOCIATION. Sec.: T. C. Penington, 2020 State St., Chicago. Annual meeting, Sept. 2-4, Saratoga Springs, N. Y.

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS. Sec.: S. F. Paterson, Concord, N. H. Annual convention, Oct. 20, Quebec.

BOSTON SOCIETY OF CIVIL ENGINEERS. Sec.: S. E. Tinkham, 715 Tremont Temple. Regular meetings on third Wednesday of each month, except July and August.

CANADIAN RAILWAY CLUB. Sec.: W. H. Rosevear, Jr., Montreal. Regular meetings on first Tuesday of each month, except June, July and August.

CANADIAN SOCIETY OF CIVIL ENGINEERS. Sec.: Prof. C. H. McLeod, 877 Dorchester St., Montreal. Regular meetings every alternate Thursday from October to May, inclusive.

CENTRAL RAILWAY CLUB. Sec.: Harry D. Vought, 62 Liberty St., New York. Regular meetings on second Fridays of Jan., March, May, Sept. and Nov., Hotel Iroquois, Buffalo.

CHICAGO ELECTRICAL ASSOCIATION. Sec.: W. J. Warder, Jr., 900 Warren Ave. Regular meetings on first Friday of each month, from October to May.

CIVIL ENGINEERS' CLUB OF CLEVELAND. Sec.: Arthur A. Skeels, 689 The Arcade. Regular meetings on second and fourth Tuesdays of each month.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL. Sec.: G. S. Edmondstone. Regular meetings on second Monday of each month.

ENGINEERING ASSOCIATION OF THE SOUTH. Sec.: Robt. L. Lund, 2102 Hayes St., Nashville, Tenn. Regular meetings on second Thursday of each month at the Berry Block.

ENGINEERS' CLUB OF CHICAGO. Sec.: B. W. Thurtell, 1223 New York Life Building. Regular meetings on first and third Tuesdays of each month.

ENGINEERS' CLUB OF CINCINNATI. Sec.: J. F. Wilson, P. O. Box 333. Regular meeting on third Saturday of each month, except July and August.

ENGINEERS' CLUB OF COLUMBUS (OHIO). Sec.: H. M. Gates, 12½ North High St. Regular meetings on third Saturday of each month, except July and August.

ENGINEERS' CLUB OF MINNEAPOLIS. Sec.: Edw. P. Burch, 1210 Guaranty Bldg. Regular meetings on third Monday of each month.

ENGINEERS' CLUB OF PHILADELPHIA. Sec.: J. O. Clarke, 1122 Girard Street. Regular meetings on first and third Saturdays of each month, except July and Aug.

ENGINEERS' CLUB OF ST. LOUIS. Sec.: H. J. Pfeifer, 920 Rialto Bldg. Regular meetings on first and third Wednesdays of each month.

ENGINEERS' SOCIETY OF WESTERN NEW YORK. Sec.: L. W. Eighmy, 13 City Hall, Buffalo. Regular meetings, first Tuesday of each month, except July and August.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA. Sec.: Chas. W. Ridinger, 410 Penn Ave., Pittsburg. Regular meetings on third Tuesday of each month.

FRANKLIN INSTITUTE. Sec.: Dr. Wm. H. Wahl, 15 South 7th St., Philadelphia. General meetings on third Wednesday of each month, except July and August. Regular monthly meetings of the various sections on other days.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Sec.: Frank P. Foster, Corning, N. Y. Meeting, September 2-4, Atlantic City, N. J.

IOWA RAILWAY CLUB. Sec.; P. B. Vermillion, Des Moines, Iowa. Regular meetings on third Tuesday of each month.

LEAGUE OF AMERICAN MUNICIPALITIES. Sec.: John MacVicar, Des Moines, Iowa. Seventh annual convention, Oct. 7-9, at Baltimore.

LOUISIANA ENGINEERING SOCIETY. Sec.: G. W. Lawes, 806 Gravier St., New Orleans. Regular meetings on second Monday of each month.

MODERN SCIENCE CLUB. Sec.: R. Henderson, 302 Livingston St., Brooklyn. Meetings every Tuesday.

MONTANA SOCIETY OF ENGINEERS. Sec.: Richard R. Vail, Butte, Mont. Regular meetings on second Saturday in each month.

NEW ENGLAND RAILROAD CLUB. Sec.: Edw. L. Janes, Back Bay P. O., Boston. Regular meetings, second Tuesday in each month, except June, July, August and September, at Pierce Hall, Copley Square.

NEW YORK ELECTRICAL SOCIETY. Sec.: Geo. H. Guy, 114 Liberty St., New York. Meetings monthly, on different Wednesdays.

NEW YORK RAILROAD CLUB. Sec.: F. M. Whyte, Grand Central Station, N. Y. City. Regular meetings on third Friday of each month, except June, July and August, at Carnegie Hall, 154 W. 57th St., New York.

NORTH-WEST RAILWAY CLUB. Sec.: T. W. Flannagan, Minneapolis, Minn. Regular meetings on first Tuesday after second Monday of each month, except June, July and August, alternating between Minneapolis and St. Paul.

PACIFIC COAST RAILWAY CLUB. Sec.: C. C. Borton, West Oakland, Cal. Regular meetings on third Saturday of each month at different cities.

PACIFIC NORTHWEST SOCIETY OF ENGINEERS. Sec.: G. F. Cotterill, Seattle, Wash. Meetings monthly in Chamber of Commerce rooms, Seattle.

RAILWAY CLUB OF PITTSBURG. Sec.: J. D. Conway, P. & L. E. R. R, Pittsburg, Pa. Regular meetings on fourth Friday of each month, except June, July and August, at Hotel Henry.

RAILWAY SIGNALING CLUB. Sec.: B. B. Adams, 83 Fulton St., New York. Regular meetings on second Tuesday of January, March, May, Sept. and Nov. Annual meeting, Nov. 10, at Detroit.

RICHMOND RAILROAD CLUB. Sec.: F. O. Robinson, 8th & Main Sts., Richmond, Va. Regular meetings on second Thursday of each month, except June, July and August.

ROADMASTERS AND MAINTENANCE OF WAY ASSOCIATION. Sec.: Chas. McEniry, Cedar Rapids, Iowa. Annual meeting, Oct. 13, 14 and 15, at Kansas City, Mo.

ROCKY MOUNTAIN RAILWAY CLUB. Sec.: J. E. Buell, 906 20th Ave., Denver. Regular meetings on first Saturday after the 15th of each month.

ST. LOUIS RAILWAY CLUB. Sec.: E. A. Chenery, Union Station, St. Louis. Regular meetings on second Friday of each month, except July and August.

SOCIETY OF CHEMICAL INDUSTRY, NEW YORK SECTION. Sec.: H. Schweitzer, 40 Stone St. Meetings on third Friday after the first Monday of each month, at Chemists' Club, 108 W. 55th St.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB. Sec.: W. A. Love, Atlanta, Ga. Regular meetings on third Thursday of Jan., April, Aug. and Nov., at Atlanta.

TECHNICAL SOCIETY OF THE PACIFIC COAST. Sec.: Otto von Geldern, 31 Post St., San Francisco. Regular meetings on first Friday of each month.

TEXAS RAILWAY CLUB. Sec.: T. H. Osborne, Pine Bluff, Ark. Regular meetings on third Monday of April and September.

TRAVELING ENGINEERS' ASSOCIATION. Sec. W. O. Thompson, Oswego, N. Y. Next meeting, Sept. 8, Chicago.

WESTERN RAILWAY CLUB. Sec.: Jos. W. Taylor, 667 Rookery, Chicago. Meetings on third Tuesday of each month, except June, July and August, Auditorium Hotel, Chicago.

WESTERN SOCIETY OF ENGINEERS. Sec.: J. H. Warder, Monadnock Block, Chicago. Regular meetings on first Wednesday and extra meetings on third Wednesday of each month, except July and August.

Personal.

—William Currie, of the Stanley Electric Mfg. Company, who for some time past has been at the Pittsfield Works as Mr. C. C. Chesney's assistant, has been appointed sales engineer of the Chicago office of the company.

—Mr. Stephen W. Baldwin retired from the management of the New York office of the Pennsylvania Steel Company on July 1st, after a service of 25 years. He retains his connection with the company in an advisory capacity and as consulting engineer, with headquarters at 71 Broadway, as heretofore. Mr. A. E. Aeby, his first assistant for the past 14 years, has been appointed to take charge of the New York office.

—Mr. Thomas Chalmers, father of W. J. Chalmers, Chairman of the Executive Committee of the Allis-Chalmers Company, died on July 13th. Thomas Chalmers was the founder of the firm of Fraser & Chalmers, which has been long recognized as one of the world's foremost producers of mining machinery, and which is now merged in the Allis-Chalmers Company.

Industrial Notes.

—At a point 145 miles north of Toronto on the Grand Trunk Railway system is reached one of the most magnificent districts in the Highlands of Ontario, known as the Lake of Bays District. The region comprises a series of connected lakes, over which large steamers are navigated. What greatly adds to the Lake of Bays value as a health-giving and sportsmen's resort is the unmatched purity of the air one breathes upon its heights. The visitor forgets his ills under its reviving influence in

less than a week, and sees life's problems in a smoother light, enjoying the good things which Nature has prepared for him. Its bracing morning breeze, which rivals the celebrated atmosphere of Pike's Peak, Col., imparts new lung power and fresh vitality. Handsomely illustrated publications describing this region and the best way to reach it will be sent free on application to F. P. Dwyer, Eastern Passenger Agent of the Grand Trunk Railway System, 290 Broadway, New York.

—The Tracy Engineering Co., of San Francisco, Cal., have recently been awarded the contract for supplying 5,000 horse power of Edgemoor water-tube boilers, and have also received an order for a Nordberg-Corliss compound engine of 2,500 horse power, for direct connection to a Wagner-Bullock alternating-current generator. Both of these orders were from the Pacific Electric Railway Co., of Los Angeles.

—The International Sewage Disposal Co., 1009 Paddock Building, Boston, has received the contract for a sewage disposal plant at the Middlesex School, Concord, Mass., where the system in use had been discarded. This company now has several plants in successful operation, among them being Mr. Thomas W. Lawson's extensive stock farm at Egypt, Mass., where sewage at the rate of fifteen thousand gallons per day is successfully treated.

—The National Engineering Co. have opened offices at 214-216 Terrace, Buffalo, N. Y., and as engineers, agents, and contractors will take up a number of branches, among which are the following: As engineers, the mechanical design of machinery, power plants, transmission systems, shops, mills, etc. As agents, they will take charge of installation work for other companies. They will also furnish bids for the making and machining of all kinds of rough castings. As contractors, they will build and install power plants.

—The Navy League of the United States has been organized to awaken public interest in the sea power of the Nation, as the chief instrument by which our country can maintain its rightful position among the world powers, and to promote, in every proper way, the efficiency of the Navy and its growth to a size commensurate with our interests upon the water and over seas. The League is strictly non-partisan in politics. It represents no class or special interest, but every man, woman and child in the United States, except members of Congress and officers and enlisted men of the Navy, is eligible to membership. The Navy League is a national organization, but is made up and maintained by sections organized and to be organized in various parts of the country. Each section has its own local organization and governing committee, controlled by its own members, and it is also represented in the national body by councillors, one of the latter being elected for each one hundred members of the local organization. Individuals may also join by applying directly to the Secretary of the Navy League of the United States, 32 Broadway, New York. The annual dues are one dollar, which entitles a member to receive all publications of the League, including the Navy League Journal, a handsomely illustrated and well written monthly, the first number of which has just been issued, and which will be devoted to the interests of the League and of the Navy. The principal officers of the Navy League of the United States are Gen. Benjamin F. Tracy, late Secretary of the Navy, president; Hon. William McAdoo, late Assistant Secretary of the Navy, vice-president; Geo. B. Satterlee, secretary; Allen S. Apgar, treasurer; and there is also a distinguished list of honorary vice-presidents, directors, founders and life members.

—At the annual meeting of the Allis-Chalmers Co., of Chicago, the following officials were elected: Chairman of the board of directors, Elbert H. Gary; president, Charles Allis; vice-president and treasurer, William J. Chalmers, second vice-president, Henry W. Hoyt; third vice-president, Phiietus W. Gates; fourth vice-president and secretary, Joseph H. Seaman; assistant secretary, Joseph O. Watkins. The consulting engineer is Edwn Reynolds, and the chief engineer, Irving H. Reynolds. The chairman reports that the development of the business of the company during the past year has been most satisfactcory, particularly in various lines not hitherto given special attention, thus giving the company in the diversity of its products broader fields

for its manufactures and greater stability for its industries. Its principal departments are now classified and its works specialized for the manufacture of steam, gas, blowing, pumping and hoisting engines, compressors and complete installations of electrical power stations, mining, metal reducing, sawmill, flour-mill, crushing, cement, waterworks and sugar machinery. The increased volume of work on hand, the extent and variety of that offered, and the enlarged facilities for its production, constitute assurances of business that justify the stockholders, as well as the management, in expecting satisfactory results for the current year.

—The Canadian General Electric Company, Ltd., Toronto P. O., Canada, is now representing the Electric Storage Battery Co. in the sale of the Chloride accumulator and the Exide accumulator throughout Canada, and all inquiries from Canada in regard to storage batteries should be addressed to the Canadian General Electric Co., Ltd.

—The A. Leschen & Sons Rope Company, the manufacturers of wire rope and aerial wire-rope tramways, have moved their San Francisco office to the Rialto Building, corner of New Montgomery and Mission Streets. Their other offices remain as heretofore, namely: 920-922 North First St., St. Louis, Mo. (the home office); 137 East Lake St., Chicago; 92 Centre St., New York; 1717-1723 Arapahoe St., Denver, Col.

—The Faraday Society, an organization to promote the study of electrochemistry, electrometallurgy, chemical physics, metallography and kindred subjects, has recently been formed in London, with the following list of officers: President, J. W. Swan; vice-presidents, Prof. A. Crum-Brown, Lord Kelvin, Sir Oliver T. Lodge, Ludwig Mond, Lord Rayleigh, Alexander Siemens, James Swinburne: treasurer, F. Mollwo Perkin; council, George Beilby, Bertram Blount, A. G. Charleton, W. R. Cooper, Sherard Cowper-Coles, F. G. Donnan, Prof. A. K. Huntington, R. A. Lehfeldt, W. S. Squire, O. J. Steinhart; secretary, F. S. Spiers, 82, Victoria street, London, S. W. Papers will be printed and circulated among members before being read at a meeting; and, with the very laudable object of avoiding increasing the number of existing publications, the council has made arrangements to publish the proceedings of the Society in *The Electro-Chemist and Metallurgist*, which will be issued monthly, free to members.

—Westinghouse, Church, Kerr & Co. have recently received orders for additional boiler and economizer equipments for the Detroit plant of the Solvay Process Co. The Solvay Co. operates, at Detroit and Syracuse, N. Y., two of the largest chemical establishments in the United States. The Detroit plant is located at Delray, a suburb on the Detroit River, and near the enormous salt deposits occurring in the marshland at this point. Steam power is furnished from a central boiler plant, which at present aggregates 7,200 H. P. Roney mechanical stokers are used throughout, and the several batteries of boiler are also equipped with Roney high-pressure, circulating-type economizers. The plant is laid out in batteries of six boilers each. The additional equipment will consist of a new battery comprising six 300-H. P. Babcock & Wilcox water-tube boilers fitted with Roney stokers, together with four additional economizers, two of which will complete the equipment of a previously installed battery. A conspicuous feature of this plant is a massive brick stack 16 feet in diameter and 260 feet in height.

Mr. W. N. Durant, of Milwaukee, the manufacturer of counting machines, is sending a neat and convenient envelope opener to his friends and customers.

—The Keystone Drop Forge Works have moved to their new plant at Chester, Pa., where they will have largely increased facilities for business.

—The Crescent Iron Works, of Springfield, Mo., the Sterling Iron Works, of Springfield, Mo., and the Aurora Foundry & Machine Works, of Aurora, Mo., have consolidated all their business, property, and interests under the name of the United Iron Works Co. The general offices of the new company will be at Springfield, Mo., and the management will be as follows: C. H. Cole, president; H. T. Hornsby, vice-president and general manager; R. P. Bowyer, secretary; A. C. Daily, treasurer; C. C. Mathey, general superintendent; A. M. Fowler, assistant general superintendent. The following are the plants acquired by the

consolidation: The Crescent Iron Works, Springfield, Mo.: the Sterling Iron Works, Springfield, Mo.; the Aurora Foundry & Machine Works, Aurora, Mo.; and the Aurora Foundry & Machine Works, Iola, Kan. In addition to these the new company has purchased outright the complete plant and stock of the Pittsburg Foundry & Machine Co., of Pittsburg, Kan., and will operate the latter in connection with the other properties.

—The Columbia Engineering Works, Inc., have taken up the manufacture of the Arthur Herschmann patent steam wagons, and are building three-ton and six-ton capacity trucks. In order to give special attion to this industry on automobile department has been established, and the shops equipped with additional tools especially adapted for this work; and upon application to the Columbia Engineering Works, Inc., William and Imlay streets, Brooklyn, N. Y., catalogues and particulars can be secured.

—The Jeffrey Manufacturing Co., of Columbus, Ohio, recently gave the eighteenth annual outing to their employees at Olentangy Park, where everybody had a good time which lasted all day and evening.

—Both the iron foundry and the new steel plant of the Diamond Drill & Machine Co., of Birdsboro, Pa., continue to run night and day, and they are shipping castings in from one to four weeks. Despite their present excellent facilities for turning out work by their modern methods and equipment, it has been found necessary to build another open-hearth furnace to accommodate the large and ever increasing volume of business. Their machine shop also shares in the general prosperity, making Birdsboro, one of the busiest towns of its size in the state.

—One of the large trunk lines has just placed an order for about 10,000 tons of heavy steel rails for the Pacific Coast. The well known house of Arthur Koppel, 66-68 Broad street, New York City, has been successful in securing this order, as well as several other large ones for other roads.

—The Ericsson Telephone Company, of 296 Broadway, New York, have recently installed one of the handsomest and most efficient multiple switchboards in the South. It is built for the magneto system, and fitted with new combination indicator jacks that have been recently patented. Experts from all over the country agree that this appliance is the most ingenious, compact, simplest and strongest on the market, and one that insures very rapid service. The board is installed for 1,200 numbers, and has a capacity for 3,000. The main distributing rack for 1,200 numbers is fitted with carbon lightning arresters and heat coils; a monitor desk, with visuals for calling and clearing, and jacks for listening was also installed. The woodwork on this board is made of mahogany, with heavy piano finish, giving it a very fine appearance.

—The Chandler & Taylor Co., of Indianapolis, have recently brought out a new line of direct-connected, automatic cut-off steam engines of the enclosed type, built strictly in accordance with the recommendations made by the American Society of Mechanical Engineers and the American Institute of Electrical Engineers for direct-connected units of this kind.

—Wm. B. Scaife & Sons Co., of Pittsburg, Pa., sole manufacturers of the We-Fu-Go and Scaife water-softening and purifying systems, have found it necessary to build an addition to their present plant at Oakmont, Pa., to accommodate their increased business in this line, and have just completed the erection of a new shop 60 feet wide by 100 feet long, equipped with the latest improved machinery, which will be used exclusively for manufacturing the We-Fu-Go and Scaife systems, in addition to their present shops. They have at the present time systems aggregating 95,000 H. P. under construction for steam boiler plants, in addition to plants for softening water to be used in manufacturing processes such as dyeing and bleaching in woolen and cotton mills, and for washing in laundries.

—The America Steam Gauge and Valve Mfg. Co., of Boston, gave their annual dinner to the members of their sales department on the evening of July 1st. Every year the traveling salesmen, the branch house managers, and the home office staff have a gathering at which the business of the company is thoroughly discussed, the meeting ending with a dinner. Among those present this year were: John McCandlish, R. B. Phillips, J. L. Weeks, W. E. Jerauld, H. B.

Nickerson and James Chambers, of Boston; U. H. Nickerson, Providence, R. I.; H. A. Crocker, Buffalo, N. Y.; Chas. Kilander and M. B. Hicks, Chicago; Richard Hewins, Philadelphia; Horace Parker, Atlanta, Ga.; Chas. A. Allen, New York; and Thos. M. Kelly, Cincinnati.

—On the application of the Merchants' Association of New York, after the Southwestern Excursion Bureau had officially declined to grant rates to New York, the Southern Pacific Co. has put in an individual special rate from Texas to New York for the fall buying season. The special merchants' fare of one and one-third for the round trip over the Southern Pacific and its affiliated lines will be in effect on July 31st-August 4th, inclusive, and August 21st-25th, inclusive, via the New Orleans gateway, on the certificate plan. The return limit on the certificates will be thirty days from date of issuance. The Southern Pacific Co. has also agreed to make the same reduced rate from points reached by its system in Texas, in connection with the water trip to New York from New Orleans on the Southern Pacific new passenger steamships. The special fare of one and one-third by rail and steamer also covers meals and stateroom while on board the boat. The Merchants' Association will send to Texas merchants in about two weeks the circulars giving full particulars as to the rates, dates, routes, etc.

—The forty-first annual outing tendered to their employees by the Lunkenheimer Company, of Cincinnati, was held at Woodsdale Island Park on Saturday, July 18th. Seven hundred employees and their families, or, in all, about two thousand people, including children, took part in the excursion, and enjoyed the many amusements that had been provided for them by the company, which assumed the entire expense. Woodsdale Island Park is about thirty-one miles from Cincinnati, and it required two railway trains of ten coaches each, to transport the excursionists.

—Wyman and Gordon, of Worcester, Mass., the manufacturers of drop and special forgings, have been increasing their business so greatly to the westward of New York, that in order to meet the demands upon them they have purchased property in Cleveland, which is bounded by Superior, Wason and St. Clair Streets, and has a frontage of 600 feet on the C. & P. Railroad. Plans are being made for extensive buildings to occupy the entire lot, so designed that they may be erected in sections as the business requires. While it is proposed to begin with a medium-sized plant, it will be conveniently arranged and will be equipped with the best forging machinery that can be procured, and will be enlarged as occasion warrants. The main office of Wyman and Gordon will remain at Worcester.

—The American Blower Co., of Detroit, Mich., have recently secured the order for three heating outfits to be installed in the new factory of the Packard Motor Car Co., of their own city; they also have orders upon their books for apparatus to be installed in the factory of Pettibone, Milliken & Co., Chicago; the Jas. Leffel Co., Springfield, O.; and the B. & O. round house at Keyser, W. Va.

—At a series of receptions recently tendered by the management of Armour Institute of Technology to the students of the American School of Correspondence, Dr. Gunsaulus, President of Armour Institute, presided, and the famous correspondent of the Chicago *Record-Herald*, Mr. Wm. E. Curtis, was one of the speakers. Mr. Curtis was so impressed with the earnestness of the 3,000 students who attended, by the character of the instruction given, and by the possibilities of this so-often-scoffed-at plan of education for wage-earners, that in the June 29th issue of the *Record-Herald* he devoted his regular daily letter to a description of the work of correspondence schools, under the title of "Education by Mail." It has been the constant aim of the management of the American School of Correspondence to raise the standard of correspondence instruction in general to the plane of serious educational work. All the officers and instructors of the school are college men, graduates from such institutions as the Massachusetts Institute of Technology, Harvard, Tufts College, Lehigh University, Dartmouth, and Armour Institute of Technology. They are men fitted by experience and education to offer sound instruction, and they are men whose sense of responsibility to their alma mater will not permit them to hold any but the highest educational ideals and standards.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Air Compressors.

Catalogue, with descriptions and illustrations of air and gas compressing machinery of every style for compressing air or gas for any purpose, pumping natural gas fields, producing dry vacuum, operating air-lift well pumps, etc.; and also of direct-acting steam pumps and other power pumps; together with useful tables and data. 9 by 6 in.; pp. 96. Hall Steam Pump Company, Pittsburg, Pa.

Briquetting Machinery.

General catalogue, No. 5, with illustrations and descriptions of modern machinery and methods for briquetting flue dust, fine ores, calcines, concentrates and other mineral fines, and blue prints giving elevations and plans of briquetting plants. 8 by 10 in.; pp. 21. Chisholm, Boyd & White Co., Chicago.

Conveying Machinery.

Catalogue No. 035, with descriptions and many illustrations of coal-handling and conveying machinery of every description, electric hoists and locomotives, narrow-gauge railways and cars, and other kinds of mechanical-handling apparatus. 9 by 6¼ in.; pp. 18. Also, catalogue No. 032, devoted to foundry ladle cars for transporting and distributing molten metal. 9¼ by 6¾ in.; pp. 4. C. W. Hunt Company, West New Brighton, Staten Island, N. Y.

Diamond Drills.

Catalogue No. 15, entitled "The Diamond Drill and Its Work," with illustrations, descriptions and price lists of diamond-pointed core drills for prospecting for minerals, and testing foundations of bridges, dams, buildings and other engineering works, with lists of parts and their weights, methods of operation, records of work performed and testimonials. 9¼ by 6 in.; pp. 78. American Diamond Rock Drill Co., 95 Liberty St., New York.

Electric Apparatus.

Bulletins, catalogues and price lists, and other pamphlets illustrating and describing controllers, arc lamps, railway line material, transformers, switchboards, meters, switches, manhole junction and fuse boxes, motors, generating sets and other kinds of electric machinery and apparatus. General Electric Company, Schenectady, N. Y.

Electric Driving.

Leaflets Nos. 100, 101, 102 and 103, showing Northern electric motors driving, respectively, a Williams cement mill, a Bickford portable radial drill, a Troy collar and cuff ironer, and a 28-inch Pond lathe. 6¼ by 3½ in.; pp. 4. Northern Electrical Mfg. Co., Madison, Wis.

Exhaust Fans.

Sectional catalogue No. 149, with illustrations and descriptions of "A B C" exhaust fans for the removal and conveying of shavings and dust, elevating and distributing of cotton and wool, removal of smoke and fumes, and for use in connection with special heating and drying plants, together with auxiliary apparatus. 9 by 7¼ in.; pp. 58. American Blower Company, Detroit, Mich.

Fillet Tool.

Booklet, with illustrations and description of Rabiger's patent fillet tool, for cutting a perfect fillet of any radius in shafting, rolls and machinery of all descriptions, and for use on lathes, planers, shapers, boring mills and other machine tools, as well as for pattern making and wood working of all kinds, and for spinning sheet metal. 6 by 3½ in.; pp. 7. Rabiger Bros. & Co., Philadelphia.

Gas-Works Machinery.

Pamphlet 118, containing an illustrated article, by P. Plantinga, on "Gas Purifiers and Purification," reprinted from the *American Gas Light Journal*, and pamphlet No. 129, devoted to ammonia concentrators for saving volatile and fixed ammonia compounds in gas liquor. 9 by 6 in.; pp. 16 and 4. The Gas Machinery Co., Cleveland, Ohio.

Induction Motors.

Circular No. 1062, devoted to induction motors for variable speed, with illustrations and descriptions of the machines and their parts, curves showing their operation and other useful information. 10 by 7 in.; pp. 32. Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Injectors.

Catalogue, illustrating and describing various types of Walworth locomotive injectors for the proper and economical feeding of locomotive boilers, Walworth stationary and Dodge automatic injectors. 8 by 6 in. pp. 22. Walworth Manufacturing Co., Boston, Mass.

Iron-Works Machinery.

Circulars, illustrating and describing lever shears for cutting steel bars, etc.; straightening machine, with rolls grooved to suit requirements; and slow-speed gear or portable roll lathe, for turning rolls in their housings. 11 by 8½ in.; pp. 5. Vulcan Foundry & Machine Co., New Castle, Pa.

Machine Tools.

Catalogue No. 4, in flexible cloth cover, with descriptions and half-tone illustrations of engine lathes, upright drill presses, radial drills, and other high-grade machine tools and their parts and accessories. Also, shipping weights and instructions and telegraphic code. 9 by 6 in.; pp. 187. The Hamilton Machine Tool Co., Hamilton, Ohio.

Marine Machinery.

Catalogue No. 16, with illustrations and descriptions of triple-expansion, compound and other styles of marine engines, marine boilers, paddle- and stern-wheel machinery, screw propellers, and other kinds of marine machinery, 9 by 6¼ in.; pp. 48. Marine Iron Works, Chicago.

Paint.

Folder, entitled "Colors and Specifications," illustrating five kinds of high-class steel and iron construction painted and protected with Dixon's silica-graphite paint, and showing the four colors recommended for use. 6¼ by 3½ in.; pp. 6. Joseph Dixon Crucible Co., Jersey City, N. J.

Pamphlet describing Galvanum, a paint that will adhere permanently to galvanized iron, with illustrations of many buildings and other structures where Galvanum has been used with success, and testimonials. 8 by 11 in.; pp. 12. The Goheen Manufacturing Company, Canton, Ohio.

Pipe.

Catalogue, bound in flexible cloth, with illustrations and descriptions of Taylor's spiral, riveted, steel pipe, made in sizes, from 3 to 40 inches in diameter, and all kinds of pipe fittings, and useful data on hydraulics. 8¼ by 4 in.; pp. 40. American Spiral Pipe Works, Chicago.

Recording Instruments.

Large catalogues Nos. 9 and 10, devoted, respectively, to the latest styles of recording pressure and vacuum gauges, and recording volt, ampere and watt meters. These well known and successful instruments are fully illustrated and described, and full-size views are shown of the charts and the different kinds of graduations. Price lists and testimonials. 11½ by 9 in.; and 12 by 9½ in.; pp. 16 and 32. The Bristol Company, Waterbury, Conn.

Rock Drills.

Pamphlet describing and illustrating the Water Leyner rock drill and its operation. In this drill the piston and tool are entirely disconnected, and the cuttings are forced from the hole by compressed air and water discharged through the tool, thus giving efficient and economical operation, with entire absence of dust. 9 by 6 in.; pp. 30. The J. Geo. Leyner Engineering Works Co., Denver, Colo.

Saw Table.

Catalogue A, with half-tone illustrations and descriptions of the new Colburn universal saw table for wood-working, which combines many novel and distinctive features and is built like a machine tool. 9 by 6 in.; pp. 19. Colburn Machine Tool Co., Franklin, Pa.

Screw-Cutting Tools.

Catalogue and price list No. 17, with illustrations and descriptions of stocks, dies, taps, screw plates with adjustable dies and guides, the Oster patent gauge or stop, and other kinds of screw-cutting tools for threading pipes and bolts, and of hand and power machines for threading and cutting off pipe. 8½ by 5½ in.; pp. 35. The Oster Manufacturing Co., Cleveland, Ohio.

Screw Machines.

Catalogue, with descriptions and half-tone illustrations of the Acme multiple-spindle full-automatic screw machines and semi-automatic screw-slotting machines, their parts and their products. In these machines all tools act simultaneously and screws are turned out with great rapidity. 6 by 9 in.; pp. 50. The National-Acme Manufacturing Co., Cleveland, Ohio.

Shaper.

Pamphlet describing and illustrating a universal shaper which is adapted to all classes of intricate punch and die work, and metal pattern and jig making. 9 by 6 in.; pp. 10. Cochrane-Bly Machine Works, Rochester, N. Y.

Steam Engines.

Catalogue No. 61, a partial list of users of the Reynolds-Corliss steam engines, built at the Edward P. Allis Works, Milwaukee. The list is a very impressive one, as these engines are employed for a great variety of purposes and are in operation in all parts of the United States as well as in many other countries in every quarter of the globe. 4¼ by 6 in.; pp. 189. Allis-Chalmers Company, Chicago.

Large catalogue, with full-page half-tone illustrations and descriptions of Bates-Corliss steam engines, air- and gas-compressing machinery, and plants where these machines are installed. 9 by 12 in.; pp. 73. Bates Machine Co., Joliet, Ill.

Steam Traps.

Pamphlet No. 152, with illustrated descriptions and prices of the Morehead return traps and tank traps for effectively handling the condensation water in steam plants, showing their operation and many advantages. 9 by 7 in.; pp. 16. American Blower Company, Detroit, Mich.

Tortilla Mills.

Catalogue 62-E with descriptions, illustrations and prices of hand and power tortilla mills, in various styles, for grinding dry or wet corn and other substances, corn and cob mills, and corn shellers and separators. 3½ by 6½ in.; pp. 22. The Geo. L. Squier Mfg. Company, Buffalo, N. Y.

Water-Wheel Governor.

Circulars, with illustrated descriptions of Replogle's duplex relay water-wheel governor and relay-returning water-wheel governor, for closely regulating the speed of water-power plants, and curves showing very satisfactory test of a new relay governor at a plant which furnishes current for an electric railway, at Matteawan, N. Y. 11 by 9 in.; pp. 4. The Replogle Governor Works, Akron, Ohio.

Wheels.

Pamphlet describing and illustrating the solid forged and rolled steel wheel for railway rolling stock, and its process of manufacture, with the special machinery used for this purpose. 6¼ by 9 in.; pp. 17. Schoen Steel Wheel Company, Pittsburg, Pa.

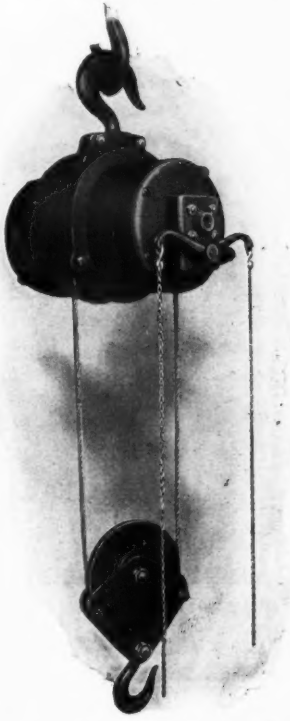
IMPROVED MACHINERY

New Processes and Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

A Pneumatic Motor Hoist.

THERE is a large class of hoisting operations which requires precision of movement, perfect control by the workman, a sustained position of the load for considerable periods, and unlimited length of lift, in places where there is a minimum of head room. For such operations a pneumatic motor hoist is particularly well adapted, and one of the best machines of its kind is the Shepard hoist, which is herewith illustrated.



THE SHEPARD PNEUMATIC MOTOR HOIST.

The Shepard pneumatic motor hoist is a thoroughly durable and reliable tool for the most exacting requirements of hoisting. It is not subject to the limitations of the piston air hoist, but is suited for every hoisting operation. Its low first cost, as compared with any other thoroughly capable substitute, will permit the hoisting plant to be subdivided into a larger number of units, each one of which may be favorably placed for the special needs of some important operation. A traveling crane is best for very heavy and hard work; a piston air hoist has another restricted field; but for real economy and all-round usefulness the pneumatic motor hoist is ahead of either.

The successful performance of the Shepard hoist is due principally to a simple and practical design, in which a piston pneumatic motor is combined in compact and symmetrical form with a spur gearing. The pneumatic motor consists of three single-acting cylinders radially mounted upon the driving shaft, each cylinder carrying a bell crank to one end of which is attached the piston, and to the other end a roller suited to revolve about a stationary eccentric fixed at the back of the hoist shell. Air pressure acting upon the pistons successively pushes them outward, causing the rollers to bear forcibly upon the eccentric just at the time they pass its highest point. As the rollers under load roll down the incline formed by the eccentric, they propel the cylinders forward in their circular path.

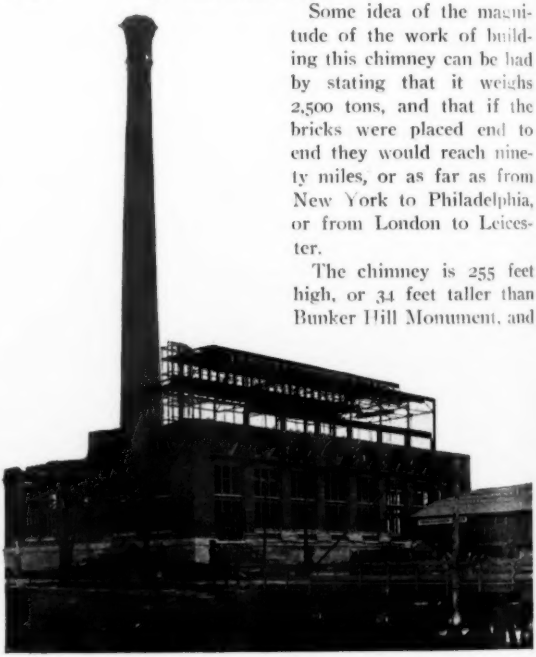
Air is led to and exhausted from the cylinders as the port openings in the hub pass alternately the supply and exhaust openings in the cover plate of the hoist shell. The pistons and hub are provided with metallic packings which automatically take up wear and keep the motor from leaking air even after long use. The bearings are not subjected to reversal of stress, and hence they do not need adjustment and will always run quietly. The small inertia

strains occurring in this motor are entirely absorbed within itself and there is absolutely no vibration. The motor runs within a closed shell and in a bath of oil, and while all parts are copiously lubricated, no oil whatever is thrown from the exhaust.

The motor is directly connected to a double train of spur gearing of ample strength, arranged for the highest possible efficiency. The gearing is enclosed and runs in a bath of oil, insuring perfect lubrication to this part of the mechanism also.

The load is sustained at all points independently of the air pressure or the friction of the hoisting gear. The spur gearing used in this hoist is far more efficient than the worm or differential types of hoisting gear, thus effecting a large saving in power, which lessens both the operating expenses and the first cost of plant.

The accompanying illustration shows the wire-rope type of the Shepard pneumatic motor hoist, which is also made in the motor-chain style. Any further information concerning either type of these useful and efficient machines will be gladly furnished by the manufacturers, The General Pneumatic Tool Company, of Montour Falls, N. Y.



CAMBRIDGE ELECTRIC LIGHT COMPANY'S STATION AND CHIMNEY.

A Very Tall Chimney.

THE accompanying illustration gives a view of the tallest masonry structure in the vicinity of Boston—the chimney of the Cambridge Electric Light Company's power station on the banks of the Charles River.

The foundation for this chimney is of concrete, consisting of 1 part Portland cement, 2½ parts sand and 5 parts of crushed granite. The chimney itself is built entirely of brick. The section of the lower part is octagonal, but that of the main portion is circular. The chimney has the usual two walls, the shell and the core, the diameter of the flue being 9 feet.

Although all the work could have been done from the inside, it was necessary to build an outside support for the covering of the high-tension electric wires in order to protect the laborers who were carrying bricks and mortar to the elevator through the temporary hole in the bottom of the chimney. The elevator was operated by a portable steam engine.

Some idea of the magnitude of the work of building this chimney can be had by stating that it weighs 2,500 tons, and that if the bricks were placed end to end they would reach ninety miles, or as far as from New York to Philadelphia, or from London to Leicester.

The chimney is 255 feet high, or 34 feet taller than Bunker Hill Monument, and 145 feet higher than the top of the State House dome, although the latter is situated on Beacon Hill.

The building of such a chimney seems like a tremendous undertaking, and, as a matter of fact, it is a big job, but to the men who have had experience in this line, it is a comparatively simple job, also.

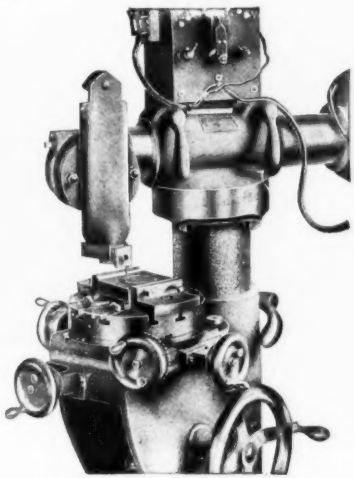
The work of constructing this chimney was performed expeditiously and economically by the most approved modern methods, Mr. Frank B. Gilbreth, of Boston, being the general contractor.

A Universal Shaper.

THE Cochrane-Bly universal shaper has been designed to cover a great variety of work in die-making and is adapted to all classes of intricate punch and die work, as well as to metal pattern and jig making. It reaches the more difficult jobs that cannot be done with the universal milling machine or ordinary shaper or slotter.

The machine is absolutely universal, so that work may be planed at every possible angle. The tool cuts from the face of the work and leaves no burr to cover the lines; it is therefore possible to machine accurately and almost no hand work is required. Sharp corners and very narrow slots may be worked out. Dies for small gears, armature plates, etc., may be accurately indexed.

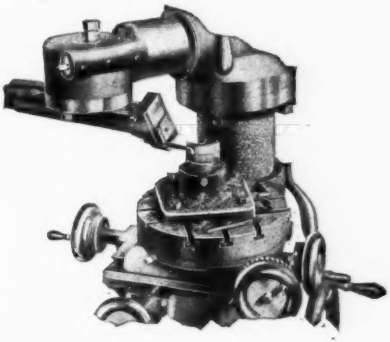
The head of the column which supports the arm carrying the working head is graduated and may be clamped in any position about the column. The arm has an out-and-in adjustment, allowing the working head to be brought to any position over the table.



SHAPER SLOTTING OUT A DIE.

The working head may be adjusted to any angle about its axis which is at right angles to the arm, and the arm may also be adjusted to any angle about its axis, thus giving every possible angle. Graduated dials are provided for both of these adjustments.

The ram is driven by a worm and wheel direct connected to a motor at the end of the arm. The stroke of the ram is adjustable. The clapper block may be adjusted to any position about the end of the ram; tools may be clamped either on the end or side.



SHAPER ROUGHING OUT A PUNCH.

The table is supported by a rigid knee, strongly gibbed to the column, the knee being raised or lowered by a screw operated by the large hand wheel at the side. The table has a circular and two cross movements. The hand wheels operating the table are provided with graduated dials for micrometer readings. The table is revolved by means of a worm and wheel which may be disengaged, thus allowing it to swing freely for quick adjustment. The cross-feed screws have ball thrust bearings and are provided with adjustable nuts to take up wear. The slack in the movement may be reduced to one-thousandth of an inch and the screw will still work freely, this being a great advantage when working in corners or narrow slots.

The table itself is graduated and the circular movement may be locked in any position. The ratio of the worm to the wheel is the same as in the universal dividing heads, which is very useful for index work.

The first figure shows the machine used in slotting out a blanking die. The two adjustments of the head make it possible to plane into a corner and give the proper clearance at both sides of the cut. A great many dies may be completely finished by this method, leaving no filing to be done.

The second figure shows the machine,

strains occurring in this motor are entirely absorbed within itself and there is absolutely no vibration. The motor runs within a closed shell and in a bath of oil, and while all parts are copiously lubricated, no oil whatever is thrown from the exhaust.

The motor is directly connected to a double train of spur gearing of ample strength, arranged for the highest possible efficiency. The gearing is enclosed and runs in a bath of oil, insuring perfect lubrication to this part of the mechanism also.

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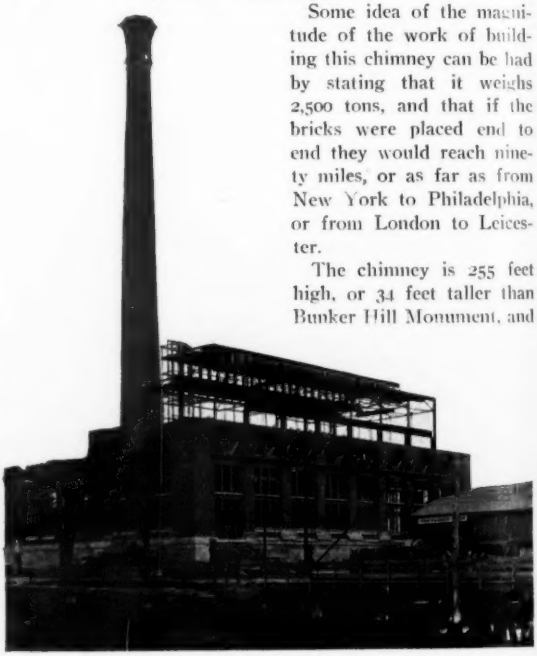

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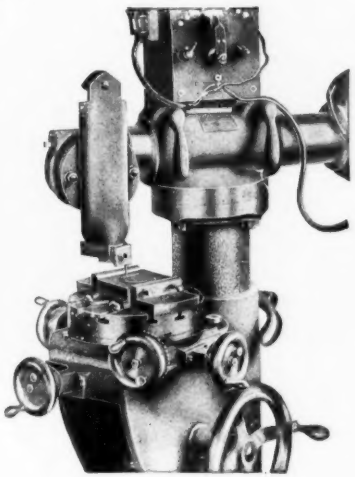
The machine is absolutely universal, so that work may be planed at every possible angle. The tool cuts from the face of the work and leaves no burr to cover the lines; it is therefore possible to machine accurately and almost no hand work is required. Sharp corners and very narrow slots may be worked out. Dies for small gears, armature plates, etc., may be accurately indexed.

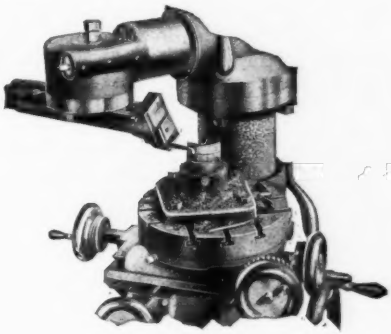
The head of the column which supports the arm carrying the working head is graduated and may be clamped in any position about the column. The arm has an out-and-in adjustment, allowing the working head to be brought to any position over the table.



SHAPER SLOTTING OUT A DIE.

The working head may be adjusted to any angle about its axis which is at right angles to the arm, and the arm may also be adjusted to any angle about its axis, thus giving every possible angle. Graduated dials are provided for both of these adjustments.

The ram is driven by a worm and wheel direct connected to a motor at the end of the arm. The stroke of the ram is adjustable. The clapper block may be adjusted to any position about the end of the ram; tools may be clamped either on the end or side.



SHAPER ROUGHING OUT A PUNCH.

The table is supported by a rigid knee, strongly gibbed to the column, the knee being raised or lowered by a screw operated by the large hand wheel at the side. The table has a circular and two cross movements. The hand wheels operating the table are provided with graduated dials for micrometer readings. The table is revolved by means of a worm and wheel which may be disengaged, thus allowing it to swing freely for quick adjustment. The cross-feed screws have ball thrust bearings and are provided with adjustable nuts to take up wear. The slack in the movement may be reduced to one-thousandth of an inch and the screw will still work freely, this being a great advantage when working in corners or narrow slots.

The table itself is graduated and the circular movement may be locked in any position. The ratio of the worm to the wheel is the same as in the universal dividing heads, which is very useful for index work.

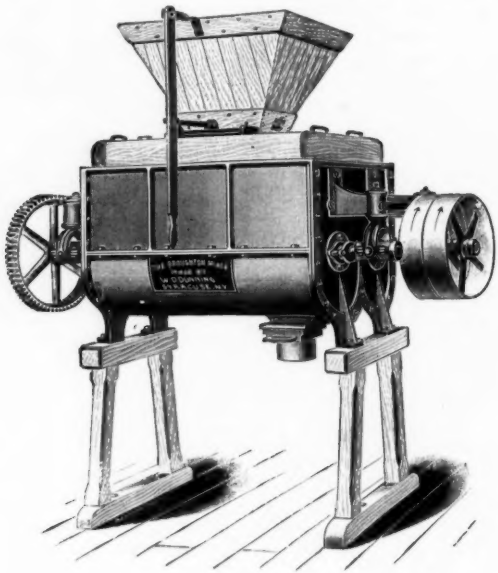
The first figure shows the machine used in slotting out a blanking die. The two adjustments of the head make it possible to plane into a corner and give the proper clearance at both sides of the cut. A great many dies may be completely finished by this method, leaving no filing to be done.

The second figure shows the machine,

with the head set for horizontal planing, at work roughing out a punch. The greater part of the stock is removed and a slight clearance groove planed around the base. Almost any shape of punch may be roughed out in this manner.

After being roughed out, the punch is finished by means of another adjustment of the shaper. By working from the face, with the lines in plain view, it may be machined accurately, leaving very little, if any, hand work.

Any more information desired concerning this shaper, will be gladly given by the Cochrane-Bly Machine Works, of Rochester, N. Y.



THE BROUGHTON MIXER.

The Broughton Mixer.

THE Broughton mixer, which is illustrated herewith, is employed in the manufacture of cement, wall plaster and all other materials requiring an intimate mixture, and is now in successful use by several prominent American cement makers.

Some tests in the mixing of fine concrete for building blocks were recently made with the Broughton mixer at the works of W. D. Dunning, in Syracuse, N. Y., where it is manufactured; and these tests proved so satisfactory that several orders for the mixer have been received from contractors who make a specialty of concrete building blocks and concrete sidewalks.

All the working parts and the mixing chamber of the Broughton mixer are constructed of iron and steel, thus making it solid and durable. When used for concrete mixing and similar out-of-door work, the machine is made in portable style, but when installed as part of a permanent plant it is raised about half way between the floors, leaving space around it for removing material. It has two shafts running horizontally side by side, geared to run in opposite directions; they run through a cast-iron case circling at the bottom, so that the paddles placed on the shaft in a screw form lift the material from the bottom of the case and throw it in opposite directions from one end of the case to the other, thereby keeping it in constant motion and obtaining a perfect mixture.

Where the shafts pass through the case, stuffing boxes are provided to prevent any leakage. All bearings run in self-oiling boxes *outside* of the case, so that the material does not come in contact with them,

thus rendering them perfectly free and durable.

The receiving chamber passes through the floor above, the upper end forming a hopper to receive the material, the lower end being fitted with a cast-iron slide arrangement, which is operated by means of a lever. This opening, being 10 inches square, affords ample room for the material to pass freely to the mixing chamber below. When the material is mixed it is dropped into a lower receiving chamber by means of a link attachment connected with two sliding doors that run on rollers and open directly under the center of each set of paddles. The doors are perfectly accessible through openings in the side of the case and can be adjusted by means of screws attached to rollers, so that the doors will always shut perfectly tight. The edges of the doors are ground to a knife edge on an angle and are in shear form, thereby cutting fiber or any other light obstruction.

On the shaft attached to the lower case, connected with the sliding doors, is a double lever, allowing the operator to let the material pass from the mixing chamber to the bags with perfect ease. In front of the lower receiving chamber are three cast-iron doors, by means of which the chamber is cleaned. At the bottom of the lower receiving chamber is a cast-iron bagging arrangement having five pockets, each provided with a slide gate and an automatic bag holder.

During the whole operation the machine does not lose any time, for while one charge is being bagged another is mixed and the third is put into the receiving hopper above.

This mixer has a capacity of 40 to 60 tons per day of ten hours—according to the facilities for handling the material and the number of men to operate it. From 1,000 to 1,400 pounds of plaster is considered a proper charge, yet at no time after the first starting of the machine is there less than from 2,000 to 3,000 pounds of material in the machine at one time.

The high speed and construction of the double set of paddles, placed on the shafts in screw form, revolving in opposite directions, makes it the only perfect mixer of hair or fiber with plaster in the market; results are obtained that are impossible with any mixer having but one shaft and one set of paddles or worm, however constructed, the latter being little better than a conveyor.

The Broughton mixers are very durable and easy to operate and designed with great care and fitted with such exactness that duplicate parts can be furnished at any time. Any further information desired will be gladly furnished by the manufacturer, W. D. Dunning, of Syracuse, N. Y.

Electric Storage-Battery Locomotive.

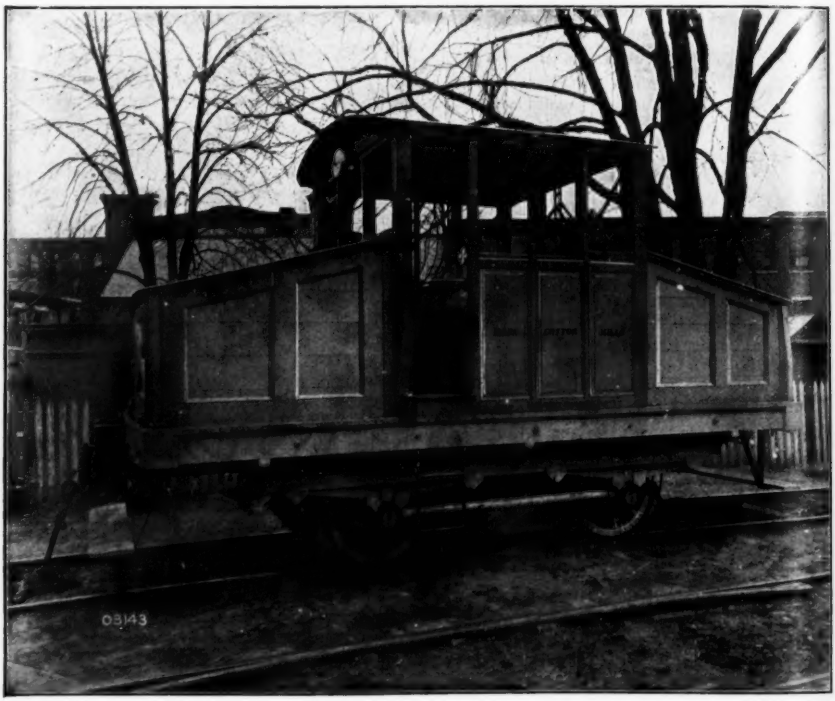
THE electric storage-battery locomotive described below has been designed with special reference to the economical handling of material in mills and other manufacturing establishments. It frequently happens that a single car load of raw materal has to be distributed at various parts of the works, and, in such cases, much costly rehandling can be saved by shifting the entire car from point to point, and discharging each portion of the load exactly where it is required. A similar economy can be effected by collecting the finished product at the different buildings, and loading each consignment directly into its proper car. The locomotive in question is used for shifting cars while loading or unloading in this manner, and also for transferring material in course of construction from one shop to another.

The simple and rugged construction of this locomotive reduces the expense for maintenance to a minimum, probably less than the cost of shoeing the horses which it replaces. The operating expenses consist of the cost of power required to charge the batteries, and the pay of one man. Even if charging current is supplied from an independent steam-driven generator, it is cheaper than any other method of handling cars, as there is no waste of energy when the machine is not in operation. A steam locomotive requires a licensed engineer and an assistant to operate it, and it greatly increases the fire risk.

The disastrous consequences which can result from the sparks of a steam locomotive when used near highly inflammable material are illustrated by a recent explosion at a plant in Minneapolis, in which eight men and two women lost their lives. The explosion is believed to have been

caused by the sparks from a switch engine, which ignited some oil, while it was being transferred from the tank cars to the tanks in the basement of the wrecked building. In cotton mills the danger is fully as great, owing to the great inflammability of the material handled.

A further advantage of the storage-battery locomotive is that it can be run on any track or switch without the expense of the erection and maintenance of a trolley wire.



HUNT ELECTRIC STORAGE-BATTERY LOCOMOTIVE.

A locomotive of this type has recently been installed at the works of the Massachusetts Cotton Mills, in Lowell, Mass. The original buildings have been improved and extended to meet the requirements of the growing business, and new structures have been added, from time to time, until the entire plant covers a considerable area. The freight siding is separated from one of the two principal storehouses by the main business street of the city, and from the second of these storehouses by the canal which supplies the turbines of the mill. It is necessary to deliver car loads of baled cotton at either or both of these buildings. Neither a steam nor a trolley electric locomotive is permissible in the storerooms on account of the fire risk.

This locomotive is built for the standard (4 feet 8½ inches) gauge, and fitted with M. C. B. standard couplings, making it suitable for use with any ordinary railroad car, and on any standard railroad track. The length over the bumpers is 21 feet 4 inches, and the height from the railhead to the top of the cab is 12 feet 1 inch. The wheel base is 7 feet 6 inches, and permits the operating of the locomotive over a comparatively small turntable. It weighs about twenty tons, and runs at a speed of

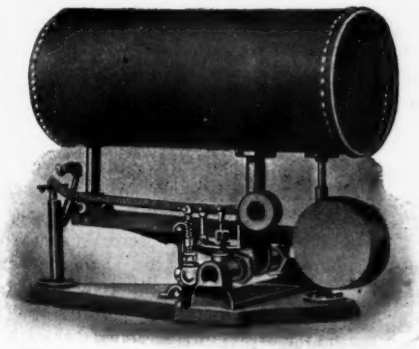
from two to four miles per hour on level track.

Experience has shown that in light switching service the batteries can be recharged at various times during the day while the locomotive is waiting between hauls. For heavier service, it may be necessary to charge during the noon hour or after working hours in the evening. The battery is automatically protected during charging by well known safety appliances which open the circuit if the current is excessive, and also when it drops so low as to indicate that the battery is fully charged. The precise arrangement of the charging station depends very largely on the details of the electric plant available, and the builders of the locomotive are glad to advise their customers as to the methods to be employed in each particular case.

This locomotive is placed on the market by the C. W. Hunt Company, of West New Brighton, Staten Island, N. Y., who will be pleased to furnish any further information concerning it, and also their narrow-gauge locomotives, which may be desired.

The Morehead Return Trap.

IN steam-heating systems it is of the greatest importance to provide a means for quickly and economically removing the condensed steam. It is extravagant to waste it, as it is pure, hot water. The most effective way to utilize the heat it contains is to deliver the water into the boiler before it evaporates, and in no other manner can the condensation water be handled as well as with a return trap.



THE MOREHEAD RETURN TRAP.

The Morehead return trap, which has been mentioned before in these columns, is distinguished for the simplicity of its design and operation, the thoroughness of its construction, and the prompt and efficient manner in which it does its work.

As is well known, this trap is located several feet above the water line of the boiler. The water from the condensing surface is forced by the pressure of steam from behind through a pipe leading to the trap, with a swing check valve close to the latter. As soon as sufficient water has entered the receiver to overcome the weight on the arm, the receiver tilts down, allowing the water to pass through the discharge pipe, at the same time opening the steam valve, which has a pipe connected with the dome of the boiler.

By equalizing the pressure on the surface of the water in the receiver with that in the boiler, the water, in simple obedience to the laws of gravity, flows into the boiler. As soon as the receiver is empty it tilts back as before, and again refills. The trap is prompt in opening and closing, its action being due entirely to gravity. When once set up it requires no further attention. It takes the water from the condensing surfaces whether they are above or below the water level in the boiler, and automatically returns it to the boiler at the temperature due to the pressure at which the steam is condensed. There is no outlet by which the steam can be wasted. The trap is quick and positive in delivering the water into the boiler against any pressure. It supplies all the water needed in the boiler from the main water pipe, providing there is enough pressure on the main to lift the water to the trap, thus performing the duties of a pump or injector. It operates equally well with high- or low-pressure coils, or coils using exhaust steam, allowing no condensation to collect in them.

Within the past few months some decided changes in the form and improvements in the construction of the Morehead

trap have been made, as shown in the accompanying illustration. A cast-iron base has been substituted for the wooden platform previously used. The drum or tank is now counterbalanced by a lever and weight having its fulcrum attached to the base. This is a great improvement over the old movement, as the weight of the water has a greater leverage in starting the tank to tilt over, and vice versa, the counterbalancing weight has a more powerful leverage to bring the tank back to its normal condition when the water is discharged.

The slight change made in the construction of the vent to the trap has overcome the necessity for the equalizing pipe which used to be on the outside of the drum. An improvement has been made in the seat and disc of the steam valve, reducing the possibility of destruction and wear.

All these things tend to greatly improve the appearance of the trap, at the same time preserving the original simplicity of adjustments in every detail.

Any further information concerning this trap will be gladly given by the manufacturers, the American Blower Co., of Detroit.

Pipe-Forcing Jack.

THE Barrett pipe-forcing jack is a special application of the Barrett jack for forcing pipe horizontally through the ground. It may be used advantageously for running service lines or for forcing pipe under lawns, sidewalks, street crossings and railway tracks, thereby saving large expense and inconvenience for ditching and refilling.

This jack consists of a cage, which travels on a rack, being moved by a socket lever and pawls. At the front of the cage is a groove and clamp for holding pipe from ¾ to 4 inches in diameter. The track has machine cut teeth, and is provided with bolts, and also carries a guide for holding the pipe in line.

The jack is placed in the ditch and the pipe started in the right direction. When the cage reaches the limit of its travel, it is drawn back to its starting point, and a new section of pipe placed in position. The operation is thus carried on until the desired distance is reached. The front or driving end of the pipe should be provided with a section of pipe one or two feet long, and a size larger than the pipe to be laid. At the front of this section it is best to place a coupling, turned to a cuting edge. This will cut its way through all reasonable earth, sticks, roots, bottles, crockeryware or like objects which the pipe may encounter.

THE BARRETT PIPE-FORCING JACK.

This jack has been thoroughly tested, and it has been found that it will pay for itself, in the saving of labor and expense, in a very short time. It is constructed throughout of malleable iron and steel in a substantial manner, and all parts are machine finished. It can be recommended for forcing sizes of pipe up to 4 inches in diameter, and further information concerning it will be gladly given by the makers, The Duff Manufacturing Co., of Allegheny, Pa.